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REPORT NO. - MSSA02-SYS-R003

REVISION 0

DATE - May 31, 1983

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PHASE IV
MARINE SEISMIC SYSTEM (MSS) DEPLOYMENT
FINAL REPORT
1 OCT 1981 - 11 DEC 1982

An investigation of techniques and deployment scenarios for installation of triaxial seismometer in a borehole in the deep ocean.

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DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DOD)

ARPA ORDER NO. 4042

MONITORED BY:

NAVAL OCEAN RESEARCH AND DEVELOPMENT ACTIVITY

UNDER CONTRACT N00014-82-C-0017

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Alexandria, VA 22314

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Sincerely,

J. A. Ballard

J. A. BALLARD
Program Manager
Marine Seismic Systems

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Newport Beach, Calif.

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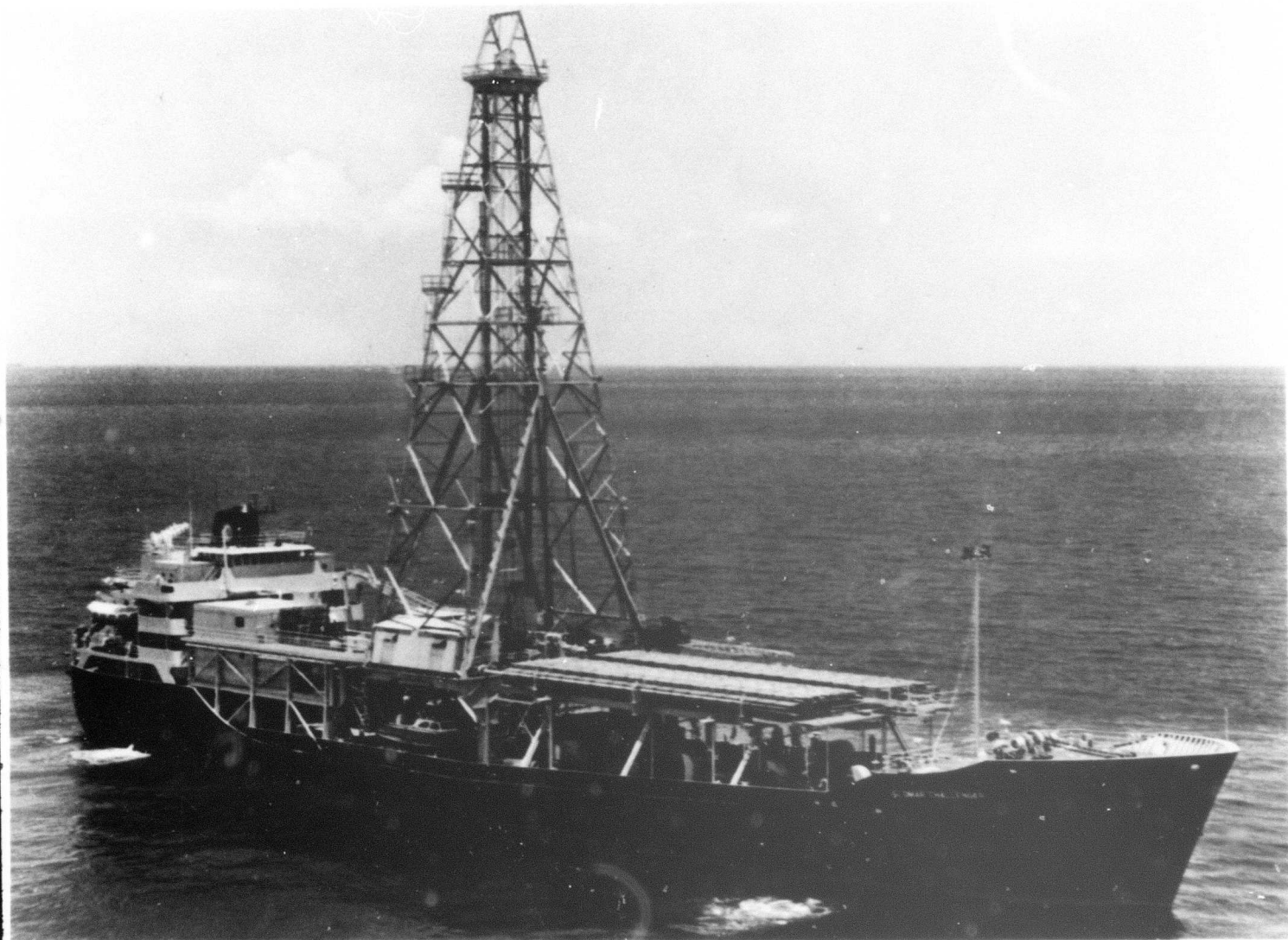
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B	MSSA02-SYS-S001, "SYSTEM INTERFACE AND REQUIREMENTS SPECIFICATION"
C	543-82-07-160; "MSS RECOVERY VESSEL MOTIONS"
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SECTION 1.0 - PHASE IV SUMMARY REPORT

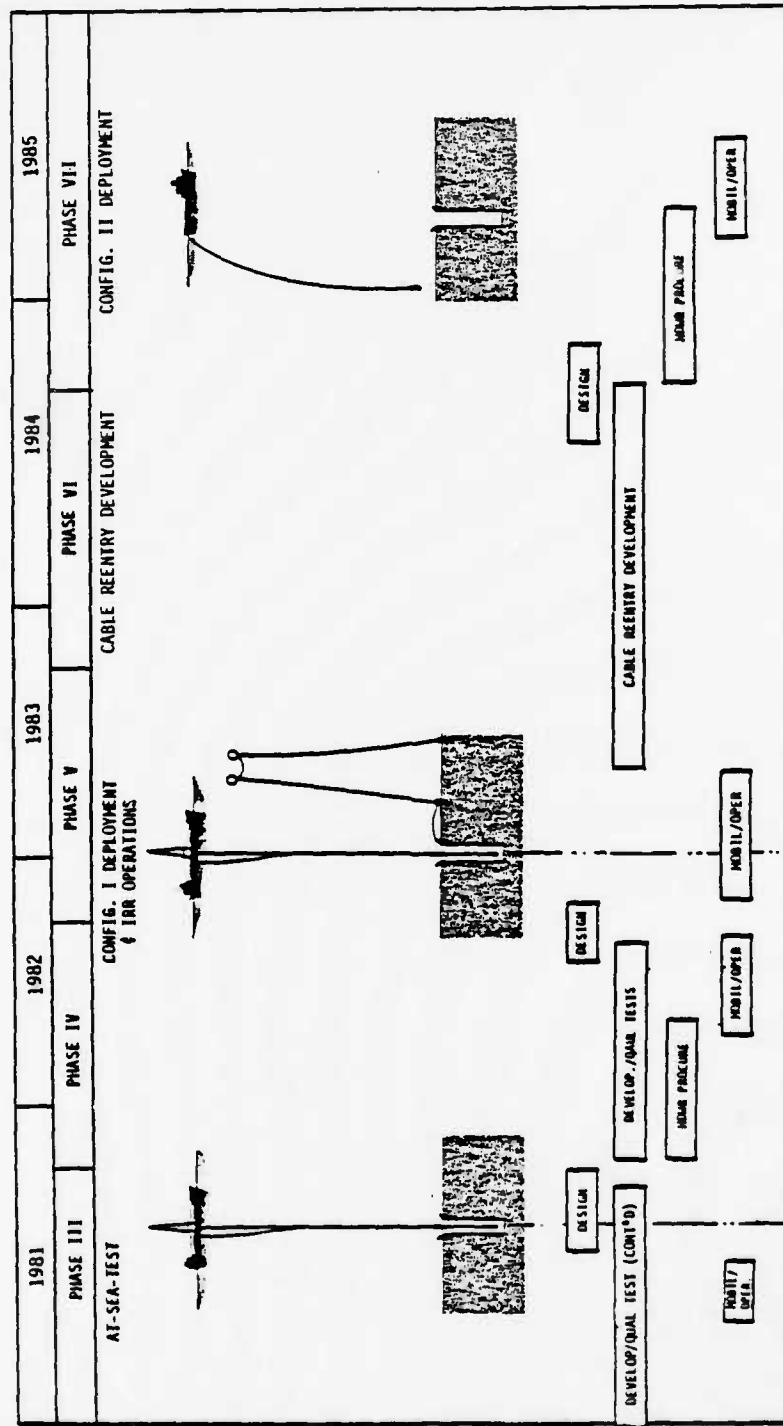
Satisfactory completion of the Phase IV portion of the MSS '82 Deployment Program was unsuccessful because the DSDP Glomar Challenger was unable to establish a deepwater borehole at the designated Northwest Pacific Site primarily because of adverse weather conditions during the limited contract period. However, all components associated with the Configuration I deployment system were fabricated and GMDI portion of the test program, integration activities and associated mobilization/demobilization efforts in Japan were successfully accomplished. During a special 30-day Glomar Challenger/DARPA operational leg only the small Hawaii Institute of Geophysics (HIG) seismometer was deployed. The subsequent Northwest Pacific IRR recovery design and planning efforts were cancelled.

Planning for a new MSS '83 BIP and IRR System Deployment which is to take place in the South Pacific was initiated during Phase IV. The overall MSS Program Plan is shown in Figure 1-1. All equipment from the MSS '82 deployment is currently available and only minimal refurbishment will be required to prepare for supporting the MSS '83 deployment and recovery operations.

A limited evaluation of the Cable Reentry technique was undertaken with primary emphasis placed on maintaining awareness of the current technology, defining basic test requirements and continuing development of a simplified cable dynamics program.

This report presents a review of the MSS '82 Northwest Pacific Operations, a description of the Configuration I deployment equipment design, an explanation of the mobilization and demobilization activities, a brief discussion of potential Cable Reentry considerations, an overall deployment program plan, and an evaluation of the MSS deployment program costs.

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FIGURE 1-1 PHASE V MSS DEPLOYMENT PROGRAM SCHEDULE

SECTION 2.0 - PROGRAM OVERVIEW

The Marine Seismic System (MSS) Program is sponsored by the Defense Advanced Research Project Agency (DARPA) and managed by the Naval Ocean Research and Development Activity (NORDA). The overall objective of the program is to develop a sensitive seismic Borehole Instrumentation Package (BIP) and associated support equipment to be deployed into the basalt layer of the ocean floor in water depths as great as 20,000 feet. Deep boreholes are to be drilled and cased through the sediment, into the basalt layer, utilizing standard deep ocean drilling techniques and equipment which have been developed during the National Science Foundation (NSF) sponsored Deep Sea Drilling Project (DSDP) using the dynamically positioned drillship Glomar Challenger owned and operated by Global Marine Inc. (GMI) Deployment of the BIP into the borehole was to be accomplished following a procedure which called for the use of a drill string to lower a reentry sub to the bottom and stab the BIP into a reentry cone which had previously been installed over the predrilled borehole as shown in Figure 2-1. The BIP deployment concept has been termed "Configuration I." The reentry sub included a sonar controlled reentry tool which was used to guide the BIP into the borehole. This reentry concept is identical to that which has been developed by the DSDP team and has been repeatedly demonstrated over more than nine years of Glomar Challenger operations. These standard DSDP procedures were only slightly modified to accommodate the MSS configurations.

Since it is possible that the Glomar Challenger may not be available to support all of the planned Seismic System Borehole DARPA deployments, it is anticipated that there will be a need to develop deepwater cable guided reentry deployment techniques which do not rely upon the capabilities of a drillship and which can utilize an appropriate ship-of-opportunity. This concept must provide for a cable towed BIP reentry package which can be guided into the borehole by maneuvering the surface ship. The Cable Reentry concept has been termed "Configuration II."

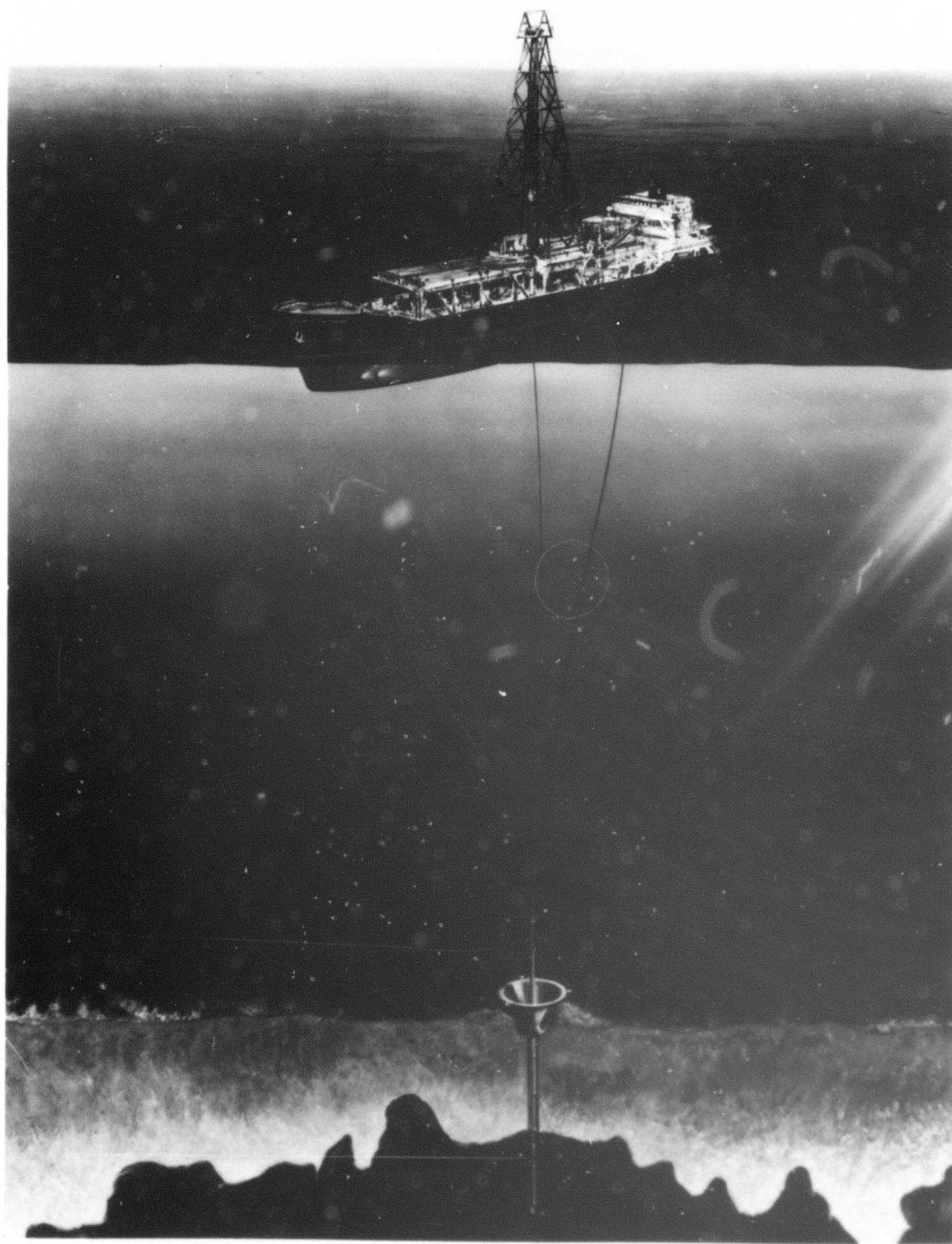


FIGURE 2-1 MARINE SEISMIC DEPLOYMENT SYSTEM

By way of summary, the overall MSS Deployment Program consists of the following major operational elements as shown graphically in Figure 1-1:

- o MSS '81 - At-Sea Test, Drill String Reentry Demonstration successfully completed in March 1981.
- o MSS '82 - Configuration I Deployment planned for the Northwest Pacific Site in August 1982 but not successfully completed.
- o MSS '83 - Configuration I Deployment plus IRR Recovery Operation at a South Pacific Site planned to take place in early 1983.

The following paragraphs summarize these five elements:

2.1 MSS '81

The At-Sea Test Demonstration of the BIP reentry was successfully completed on 30 March 1981. The Glomar Challenger implanted and recovered a BIP using an existing DSDP borehole in the mid-Atlantic in only 74 hours. Feasibility of BIP deployment using the drill string reentry technique (Configuration I) and the basic capabilities of the seismic sensor when deployed in a deep ocean borehole were demonstrated (see References 1 and 2).

2.2 MSS '82

During the follow-on MSS '82 operation in August-September of 1982 the Glomar Challenger crew attempted to drill one reentry borehole and emplace a Configuration I BIP at a Northwest Pacific Site. A 30-day special DARPA operational leg was scheduled to deploy the BIP and the associated IRR equipment, however, due to adverse weather conditions and minor equipment malfunctions drilling of the reentry borehole could not be successfully accomplished in the time period allotted.

2.3 MSS '83

Another borehole emplacement and deployment of an MSS '83 Configuration I BIP is being planned for a new site in the South Pacific. This operation is scheduled to take place during January-February 1983. To accomplish this a second special operational leg (leg #91) is currently being negotiated with NSF/DSDP to again use the Glomar Challenger. The associated IRR recovery leg will take place in March 1983. Appendices A & B present the test plan and interface requirements specification for these activities.

SECTION 3.0 - CONCLUSIONS & RECOMMENDATIONS

3.1 CONCLUSIONS

The feasibility of deploying a large instrument package into an encased subbottom borehole has been demonstrated. The 1981 mid-Atlantic MSS At-Sea-Test verified that the concerns associated with controlled reentry, large impact forces, cable entanglement, release and lowering of the instrument package into a borehole can be generally resolved. In addition, the BIP can also be recovered. Although the addition of the Bottom Processing Package (BPP) and associated IRR mooring equipment will complicate the overall operation, and extend the on-site time required, no major difficulties are foreseen.

Despite the temporary set back caused by the unsuccessful MSS '82 operation the program team is convinced that a deep water borehole can be drilled at the designated DARPA site in the Northwest Pacific (see Paragraph 4.3). The combination of weather, deep water, and chert formations contributed to the unsuccessful MSS '82 operation. Therefore, there are a number of technical considerations which must be implemented to improve future chances of success:

- o Assure the use of quality drill string
- o Use a motion compensator on the drill string
- o Use special muds for coring in chert formations
- o Cement the hole if bridging occurs
- o Modify casing slip joints by building in splines or antirotation lugs
- o Drill out hole to deeper depth to accept the casing
- o Provide approximately 6,500 feet of 5 1/2 inch drill pipe to provide additional strength in the upper sections of the drill string

All of the above recommendations will be considered for the South Pacific deployment planned for early 1983.

3.2 RECOMMENDATIONS

The following recommendations resulted from the Phase IV effort:

- o Efforts should continue as planned for the MSS '83 demonstration at the proposed South Pacific site using the drill string deployment technique (Configuration I).
- o Negotiate with NSF for emplacement of DARPA borehole at the Northwest Pacific site.
- o Set-up a specific Cable Reentry deployment working group to oversee joint implementation of available equipment and techniques.
- o Operations should allow for weather and equipment failure downtime.
- o An improved drill pipe should be utilized.
- o For deeper holes and in bad weather areas, a heave compensator for the drill string is advisable.
- o Special muds and cements should be provided for difficult drilling conditions.
- o Alternate deployment ships should be considered to provide control over deployment sites and schedules.

SECTION 4.0 - REVIEW OF MSS '82 NORTHWEST PACIFIC OPERATIONS

4.1 BACKGROUND

The drilling of a borehole for the MSS '82 implantation of a BIP at Site 581 in the Northwest Pacific Ocean (see Appendix B) was to have been accomplished using proven methods, equipment and procedures developed by the Glomar Challenger DSDP operational and scientific crew. Boreholes have been drilled in similar depths and at various locations throughout the world by the Glomar Challenger. The responsibility for the completion of the MSS '82 borehole was assigned to the Scripps Institution of Oceanography (SIO) DSDP group and Global Marine Drilling Company (GMDC) Glomar Challenger crew. The procedures used and the decisions made were the responsibility of the DSDP personnel, although GMDI and NORDA input was considered in most situations. This was a reasonable approach due to the previous accomplishments of the DSDP personnel and their expertise in the field of deep ocean coring.

BIP modifications required the lengthening of the carriage housing. Other slight modifications to improve the operational reliability were incorporated. The modified system was repeatedly tested to assure that it met the design requirements and was functionally reliable. In addition a Baker RB-2 Equalizing Valve was substituted for the Baker Mod K and Otis Tools, used on the MSS '81 work thereby reducing wire line trips required to align the BIP from two to one. The procedure is to strip the wire line through a wire line packer at the top of the drill pipe, attach the Baker RB-2 valve to the end of the Sinker Bars and run in through the drill pipe. The tool will seat on a no-go stop built into the hydraulic control sub at the top of the carriage housing. The wire line packer is pressured up with the cement pump to seal around the wire line, and the shifting of the BIP is accomplished. The retrieval of the RB-2 valve is accomplished by releasing the pressure on the wire line packer and simply pulling it out of the drill pipe. See Reference 3 for detailed operational procedures.

The Installation Recovery and Reinstallation (IRR) System was designed by the Naval Civil Engineering Laboratory, Port Hueneme, California. Deployment and recovery procedures were developed using a Navy T-ATF-class tug as the recovery ship. Recovery procedures to be used for MSS '83 recovery will require some modification because an AGS-class vessel will be substituted for the T-ATF. The required changes and alterations are currently in the design and appraisal stage and will be completed well in advance of the planned 1983 deployment. It is not anticipated that the procedural changes will be substantially different from those previously planned. Original procedures are presented in Reference 3.

4.2 BOREHOLE EMPLACEMENT HISTORY

4.2.1 Equipment Installation

The Glomar Challenger arrived in Hakodate, Japan at approximately 0900 hours August 18 and MSS equipment installation began within an hour. The installation of the equipment and the testing was finished at 1500 hours August 19 for a total time of only 30 hours. All additional equipment and stores were loaded on board and at 1200 hours August 20, 1982 the Glomar Challenger departed. The total elapsed time from arrival to departure was 51 hours.

4.2.2 Establishment of Borehole "A"

On Tuesday, August 24, the Glomar Challenger arrived on location and the ASK Beacon dropped at 1412 hours. Total transit time was 4 days, 2 hours and 12 minutes. A short bathymetric/seismic survey was made to determine topography and sediment thickness around the drill site. Water depth at the site was 5,486.12 meters (18,003 feet).

Keelhauling of the cone is a critical operation. Because weather conditions were marginal operations were suspended until 0600 August 25. Then, the reentry cone was launched and keelhauled under

the moonpool and secured. Seven joints of 16 inch diameter casing (approximately 215 feet) was made up, run through the cone and latched into the casing housing. The reentry cone and casing was run in to the seafloor and jettied 66 m into the sediment. The wireline release/shifting tool was run, the casing was released and the coring operations began.

The hole was drilled through the sediment and about 16 m into the basalt. Scattering chert nodules were encountered in the lower 70 m of sediments and became the predominant material 4 to 5 m above the basement contact. On all three drill holes considerable torquing and sticking of the drill bits were experienced over the lower 5 m of hole where the sediment was almost entirely chert. However, in all cases the tools were worked free after 45 minutes to 1 hour of circulation, pulling and working of the bumper subs.

The desired penetration of 16 m into the basalt was reached, the hole flushed clean, and mud spotted for a wiper trip into the casing. The drilling assembly was pulled into the 16 inch casing and operations were suspended for cutting and slipping of the drilling line. After operations resumed, the return trip to the bottom indicated the hole was ready for the 11-3/4 inch casing. During the trip out, the drill pipe broke in the first pipe joint above the drill collars. The BHA was lost and the hole abandoned.

Inspection of the break indicated that there may have been a manufacturing lamination in the drill pipe. Subsequent evaluations indicated that the failure contributed to a compressive loading. A laboratory inspection is being made to confirm these suspicions. The dynamometer graph of the load indicates a loss of weight from the time operations were stopped for the drill line cutting and resumption of operations. The weight loss was not readily apparent while the operator was observing the weight indicator at the drillers console because of the ships motion and the consequent oscillation of the Martin Decker load indicator.

No attempt was made to fish for the tools because of the donut ring and the limited time remaining. The donut ring is part of the casing release tool and sits in the throat of the reentry cone. This ring is normally picked up and recovered when the BHA is pulled out of the hole. In this instance, the presence of the donut ring would not allow normal fishing tools to enter the cone. The possibility of recovery of the ring by fishing was limited by the lack of fishing tools on board. A field designed and fabricated tool would have only a marginal chance of success. Secondly, a new hole would be drilled in less time and with a greater chance of success.

4.2.3 Establishment of Borehole "B"

On 29 August, a new drillsite was established about 400 feet SW of the original pilot hole. Cone and BHA were quickly readied but the casing release tool required that the release paddles be ground before the tool functioned properly. The cone was jetted in normally until it was approximately 12 meters (39.37 feet) above the seafloor. Then penetration stopped and it became necessary to work the casing up and down. The casing finally stuck with the reentry cone 9 meters (29.53 feet) above the seafloor. All efforts to free the casing and start a new hole were unsuccessful. The core was released because it could still be used if it stayed erect. The wireline shifting tool was run repeatedly without releasing from the cone. A possible bent bumper sub mandrel was suspected. A maximum pull was taken on the drill string while attempting to shift the sleeve. Finally the sleeve shifted, the tool released from the cone, and the drill string was pulled free. Upon retrieval it was found that the bumper sub immediately above the tool had been bent. The damage to the bumper sub probably occurred while attempting to free the stuck casing.

4.2.4 Coring the Hole

The hole was drilled through the chert and into the basalt to the casing depth. As before the tools frequently stuck in the chert layer but were successfully worked free. The hole was circulated,

conditioned, and readied for the 11-3/4 inch casing. The tools were pulled to the top of the reentry cone while the EDO tool was run to confirm that the cone remained in a vertical position.

The 39 joints of 11-3/4 casing, two - 20 foot slip joints and the 11-3/4 casing hanger were made up on the running tool and run into the top of the reentry cone. Reentry was difficult because a malfunctioning line wiper damaged two EDO tools. The casing was run to the bottom and landed in the normal fashion. Circulation was established and the casing cemented with 735 sacks of class A cement. After the cement was displaced an unsuccessful attempt was made to pull out of the casing and recover the drill string. Although the drill string rotated freely and circulation was maintained, the casing would not release. Finally it was determined that the casing was 6 m above the landing housing and still attached to the running tool. Due to an approaching typhoon, the Captain decided that the ship must leave the site. A string shot explosive shape charge was run and the drill string severed at the first joint above the top bumper sub. Figure 4-1 shows the assumed borehole configuration at Site 581-B after the drill string was shot loose. The pipe was pulled from the seafloor and the ship and equipment were secured for severe weather. The ship then got underway to steer clear of the typhoon. Alternative means of implanting the MSS BIP were considered, but due to equipment shortages, time, and weather, the MSS-82 goals would not be reached during DSDP Leg 88.

4.2.5 Deployment of the HIG Borehole Seismometer

On September 8, after Typhoon Gordon passed to the North, the ship returned to Site 581 where at 2000 hours, Hole 581C was begun. The Hawaii Institute of Geophysics (HIG) borehole seismometer was included in the MSS-82 experiment as a backup and/or complement to the MSS BIP. When efforts to drill and case a borehole were abandoned, the remaining time was used to successfully implant the HIG borehole seismometer and complete the seismic refraction originally planned. After completion of the experiments, the ship departed for Yokohama, Japan at 2400 hours, September 14.

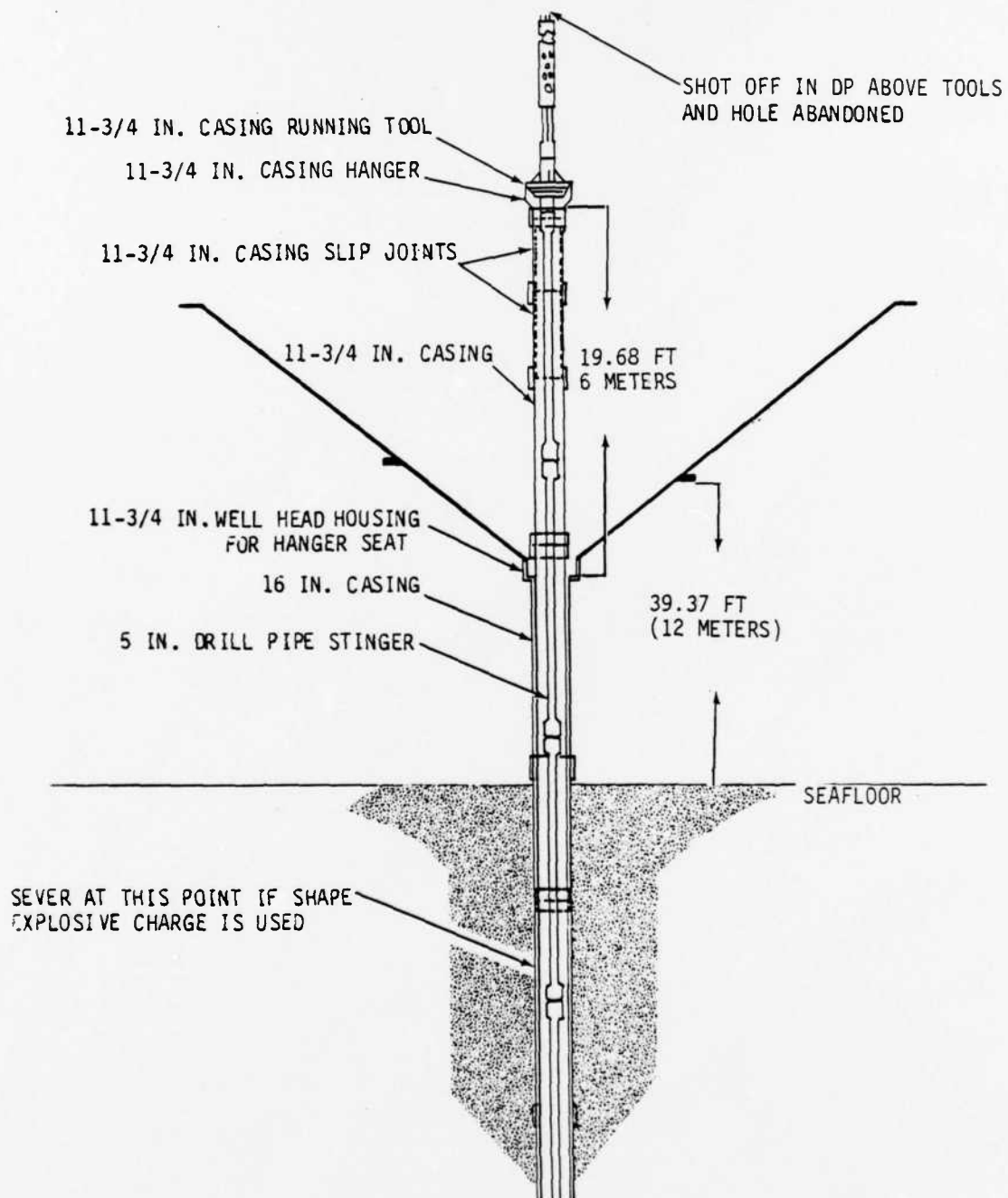


FIGURE 4-1 CONE AND CASING AT SITE 581-B AS ABANDONED ON SEPTEMBER 5, 1982

4.3 OPERATIONS CRITIQUE

The following factors influenced the borehole emplacement failures.

4.3.1 Drill Pipe Failure on Borehole A

- o The quality of the drill pipe, though new, was questionable. There may have been a flaw in the tube when manufactured. Visual inspection of the break indicates there may be laminations in the metal at the point of the failure.
- o There had been other failures in the body of the drill pipe on previous trips that were unexplained or that could not be attributed to abuse by the drilling crew. However, although it was known that the quality of the drill pipe was marginal, it was the only pipe available for the test.
- o The maximum allowable pull on the drill pipe, when stuck in bottom, is limited for the depths at which work was being done (19,200 feet). This restriction limits the options available to free the stuck tools and requires utilization of the bumper subs more than would normally be required.
- o The bottom joint of drill pipe may have repeatedly been placed in tension and compression when trying to free the stuck tools.
- o Laboratory inspection of the recovered pipe end is currently in progress and GMDI will be informed of the results.
- o The methods used by the drilling crews when freeing the pipe were acceptable for the situation and the procedures used were appropriate.

4.3.2 Stuck Casing

- o Although the ship was moved only 800 feet from the original hole (581-A), (400 feet from pilot hole) the cone and casing could not be jetted to full depth because of the pressure of an unexpected layer of coarse, granulated shale.
- o The cone and 16-inch casing assembled for hole 581-B was identical to the hole 581-A assembly.
- o Chert was encountered before the casing reached the desired depth.

- o Jetting in of the casing in unconsolidated sediments was difficult.
- o Binding and sticking of casing or tools in sedimentary sections containing chert nodules is a common problem especially when seawater is used as the primary drilling fluid.
- o At a depth of 19,000 feet the maximum allowable pull on the drill pipe (640,000 pounds) was not sufficient to free the casing when it became stuck.
- o When unable to pull a stuck string free and bumper subs are in the string, it is a normal practice to use them to the maximum to free the pipe, thus they become a fishing tool of sorts and can be made to induce a jarring effect both up and down.
- o The attempt to free the stuck casing apparently caused the bending of the bumper sub mandrel, which in turn made the shifting release tool difficult to function.

4.3.3 Shooting Off of Pipe and Loss of 581-B

- o When coring through to the basalt, chert nodules in the sediment continued to be a problem with the tools occasionally sticking and requiring efforts to work them free.
- o The desired depth was reached and the hole was satisfactorily prepared for the running of the 11-3/4 inch casing.
- o The casing was run and indications were that the shoe reached bottom and the casing hanger had engaged with the housing.
- o Cementing of the casing was routine.
- o Normal DSDP procedure was to run two 20 foot long splines with anti rotation splines built into them which prevented the splines from rotating freely but to telescope closed or open easily. The anti-rotation splines did not work.
- o It was suspected the hole had bridged and that the casing stopped on the bridge and the slip joints closed to a point where the casing hanger snap ring was a few inches above the snap ring recess of the casing head housing.
- o The total suspended weight of the string was near the maximum allowable. (On the pull test, the ship heaved and the weight indicator indicated an acceptable pull of 30,000 pounds).

- o The next step was to rotate the drill pipe out of the casing hanger. However, the snap ring did not engage in the housing because there were no splines built into the slip joints. The casing simply rotated and did not release the pipe from the casing hanger.
- o In cementing downhole, the cement slurry is pumped out and up the annulus and generates a piston effect capable of forcing the pipe out of hole unless the snap rings are engaged with the housing. There were four 20 foot bumper subs in the running string and two slip joints in the casing string capable of a maximum hydraulic displacement of 60 feet. Partial hydraulic closing of the bumper subs and the casing slip joints could explain why the casing was logged as being 6 meters (19.69 feet) higher than intended.
- o It is possible but very unlikely that the running tool reengaged while cementing was in progress. For the running tool to reengage, the upper drill string would be required to rotate sufficiently to engage the very coarse (approximately 1/2-inch) threads and if the casing hanger had been engaged and rotated out it would be near impossible to hydraulically force up the casing or to pull the casing to a point 6 meters higher than intended.

SECTION 5.0 - MSS '82 CONFIGURATION I DEPLOYMENT EQUIPMENT

5.1 GENERAL DESCRIPTION

The equipment used during the MSS '82 deployment operations is divisible into shipboard and subsea equipment. The shipboard equipment consisted of a dual bull wheel EM cable winch supplied by NORDA; a specially constructed over the side A-Frame; a single cylinder heave compensator, adapted from a guideline tensioner; an idler sheave; and a large swiveled sheave block. This equipment was mounted on the portside of the main deck of the Glomar Challenger between the derrick subbase and the casing support rack. Figure 5-1 and 5-2 show the general layout of this shipboard installation.

5.2 SUBSEA EQUIPMENT

The subsea equipment consisted of a reentry sub, which was attached to the lower end of the drill string, and a specially designed coaxial EM Cable provided by NORDA. The reentry subassembly was made up of a carriage housing, stinger and control sub. The reentry subassembly incorporated a shock mount intended to absorb the impact on the BIP during reentry into the borehole. Appendix D contains the drawings pertaining to the MSS '82 equipment and installation on the Glomar Challenger.

5.3 SHIPBOARD EQUIPMENT & MODIFICATIONS

MSS '82 equipment, although similar to MSS-81 equipment, incorporated design changes to improve handling, reduce stress levels, and shorten downhole operational periods. Figure 5-2 shows the arrangement of this equipment on the Glomar Challenger.

5.3.1 EM Cable Winch

The EM Cable Winch was supplied by NORDA and was the same one that was used during the At-Sea Deployment exercise conducted in the

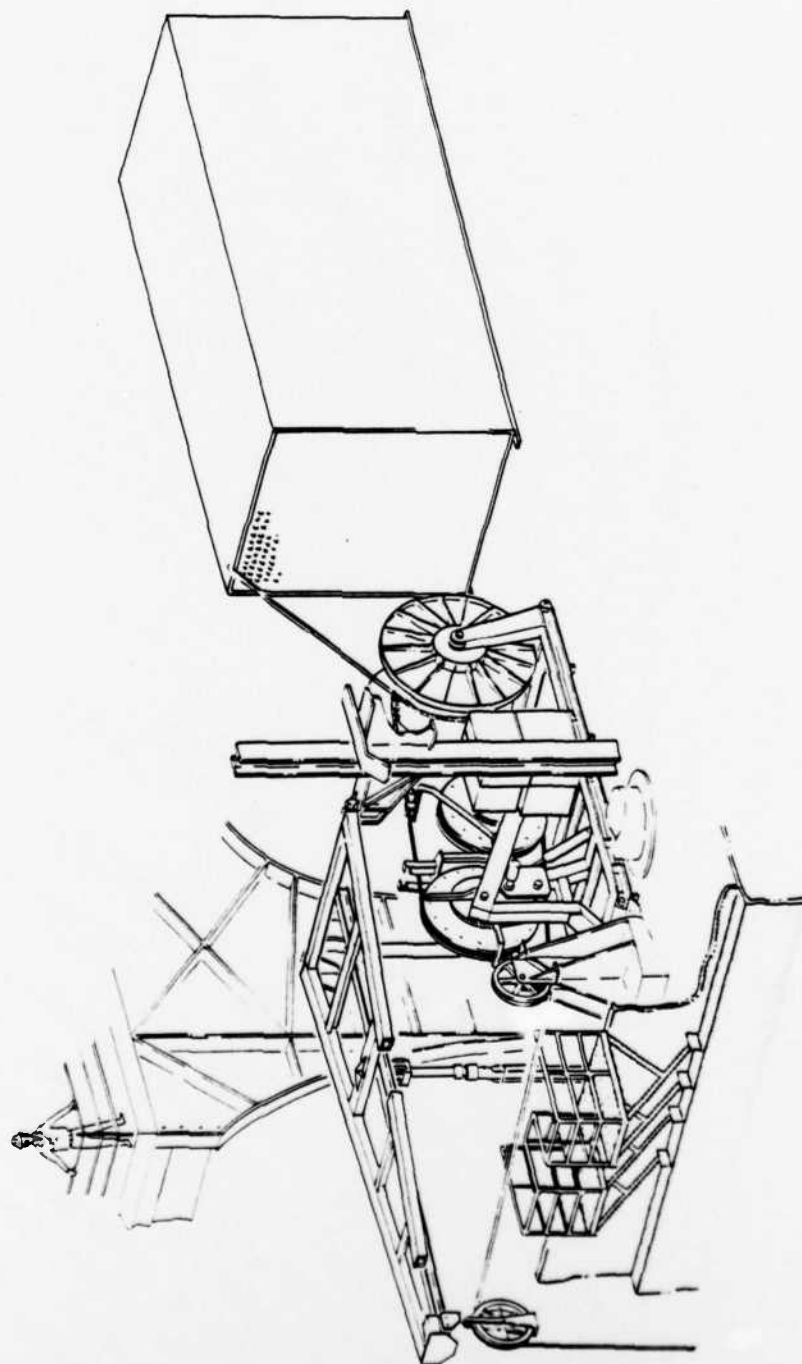


FIGURE 5-1 MSS '82 SHIP BOARD SUPPORT EQUIPMENT INSTALLED ABOARD THE GLOMAR CHALLENGER

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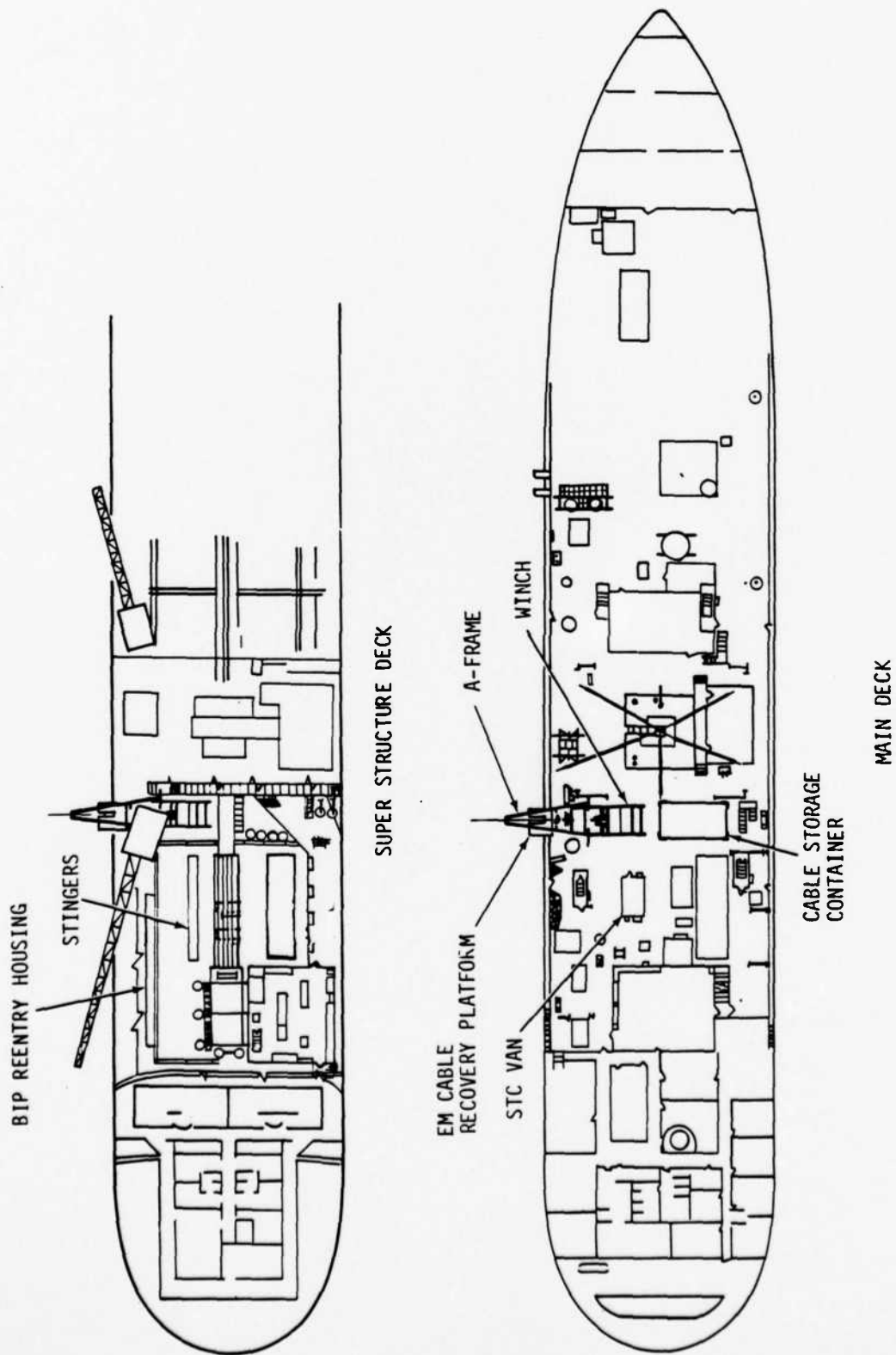


FIGURE 5-2 MSS '82 GLOMAR CHALLENGER ARRANGEMENT

Atlantic in March of 1981. The winch was refurbished at the Pengo factory early in 1982. Figure 5-3 shows the modified Pengo Winch prior to shipment.

5.3.2 A-Frame

The A-Frame was a newly fabricated structure strengthened for the greater loads anticipated during the BPP Deployment & Recovery operations. During the operation it became apparent that the swivel sheave had to be changed to improve safety during deployment of the BPP Mooring System. The swivel sheave was remounted on an I-Beam trolley that could be moved inboard by a jacking screw manually driven by a chain wheel through a 10 ton Duff-Norton Jactuators. The gear ratio of the Jactuator was chosen so that the trolley could be held in any selected position without requiring a special securing mechanism. Figure 5-4 shows the A-Frame without the lead screw installed.

5.3.3 Heave Compensator

An additional eleven gallon accumulator bottle was added to the one existing bottle already on the heave compensator. This additional accumulator improved the overall operational response of the system. Figure 5-5 shows the heave compensator and Figure 5-6 is the associated HC control panel.

5.3.4 Idler Sheave

The idler sheave was modified by adding a "strain-sert" pin and "load-all" indicator. The indicator was calibrated to give a direct reading of the tension in the EM Cable. The redesigned idler sheave also included a relocated Martin-Decker load cell. However, during operation it was determined that this load cell functioned better in its original position, between the end of the A-Frame and the swivel sheave. Figure 5-7 is a close-up view of the idler sheave with the "strain-sert" load cell installed. The original Martin-Decker digital indicator was not utilized because the heave compensator

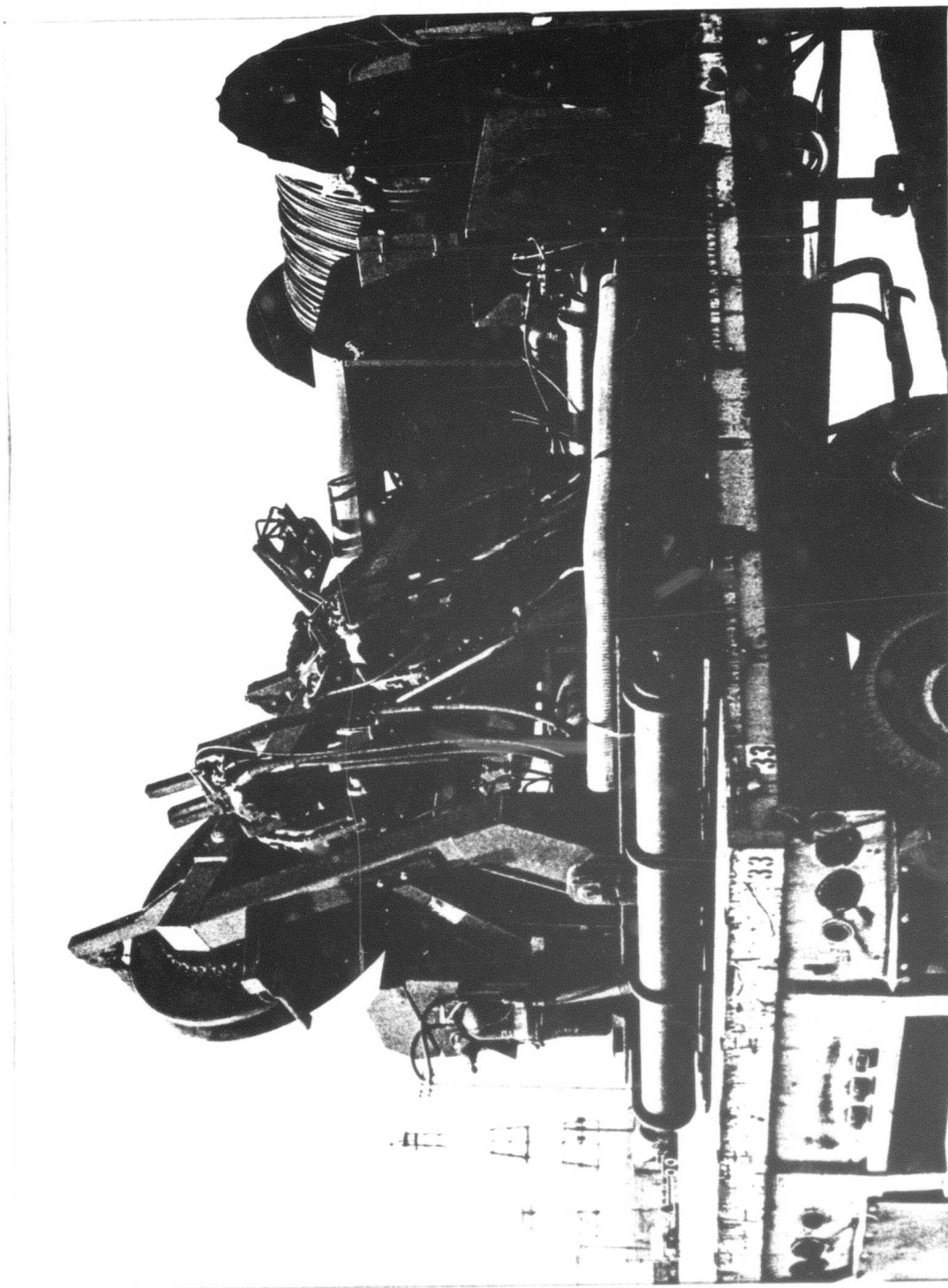


FIGURE 5-3 MSS '82 PENGO EM WINCH

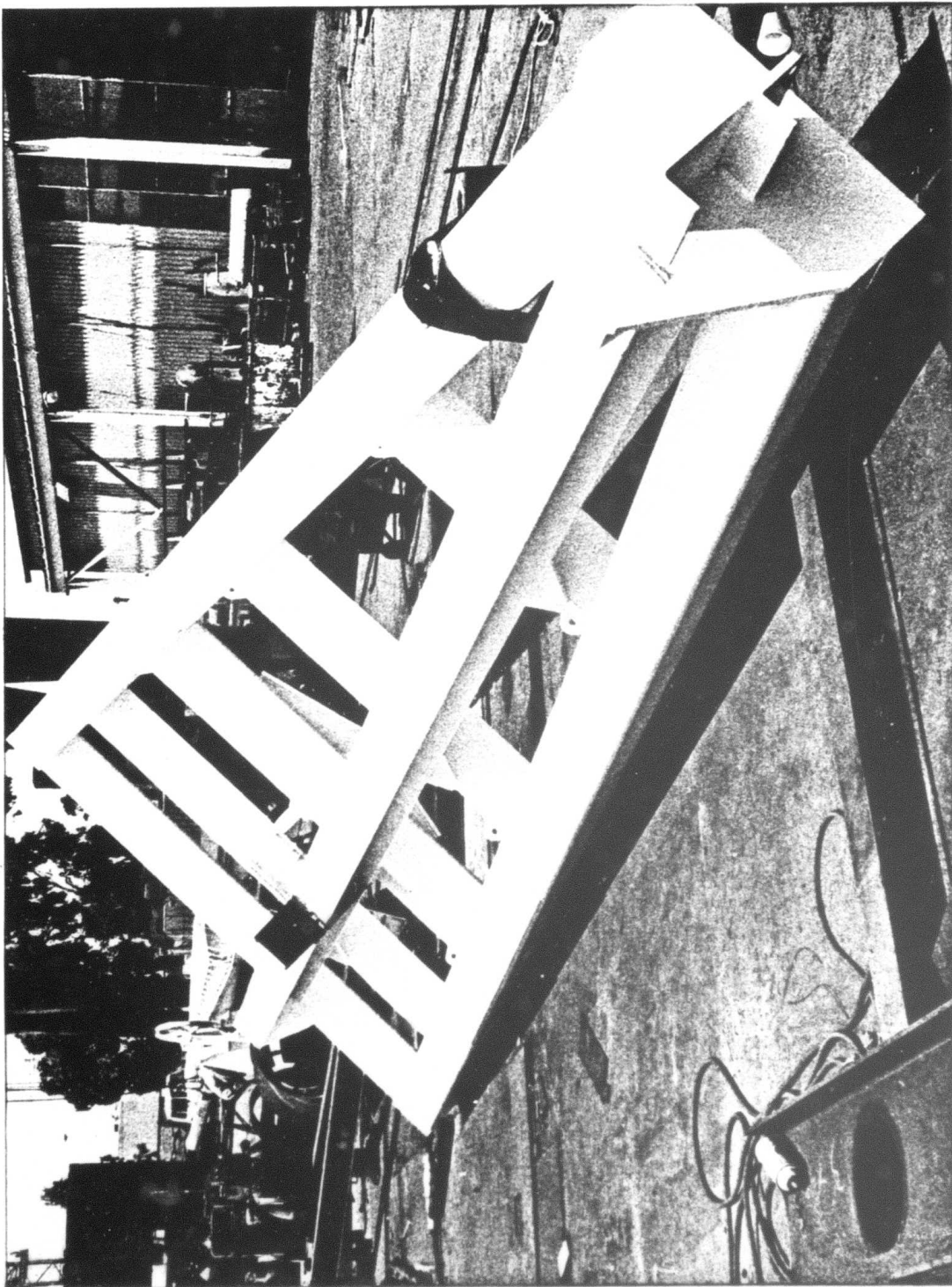


FIGURE 5-4 MSS '82 A-FRAME

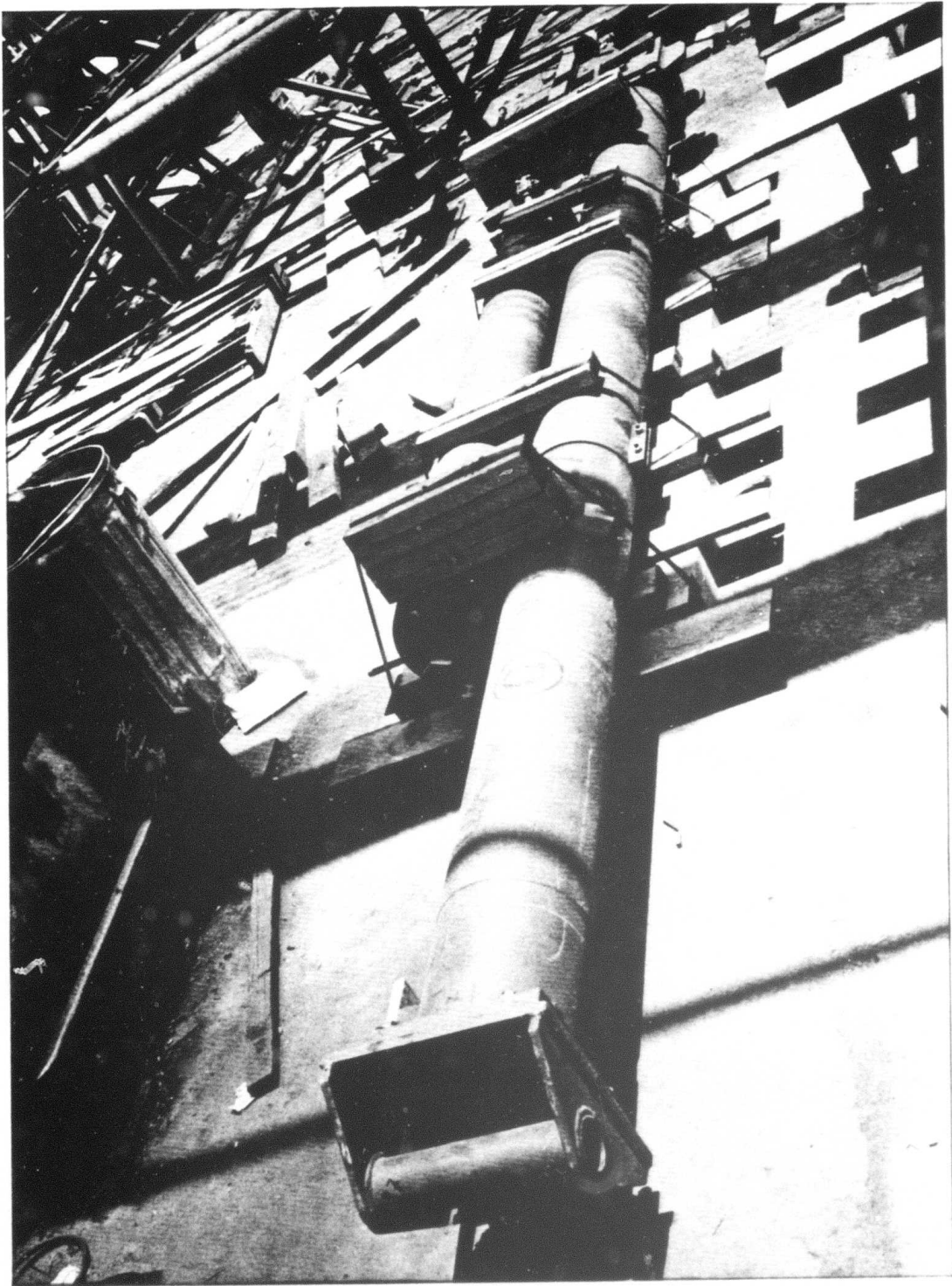


FIGURE 5-5 MSS '82 HEAVE COMPENSATOR

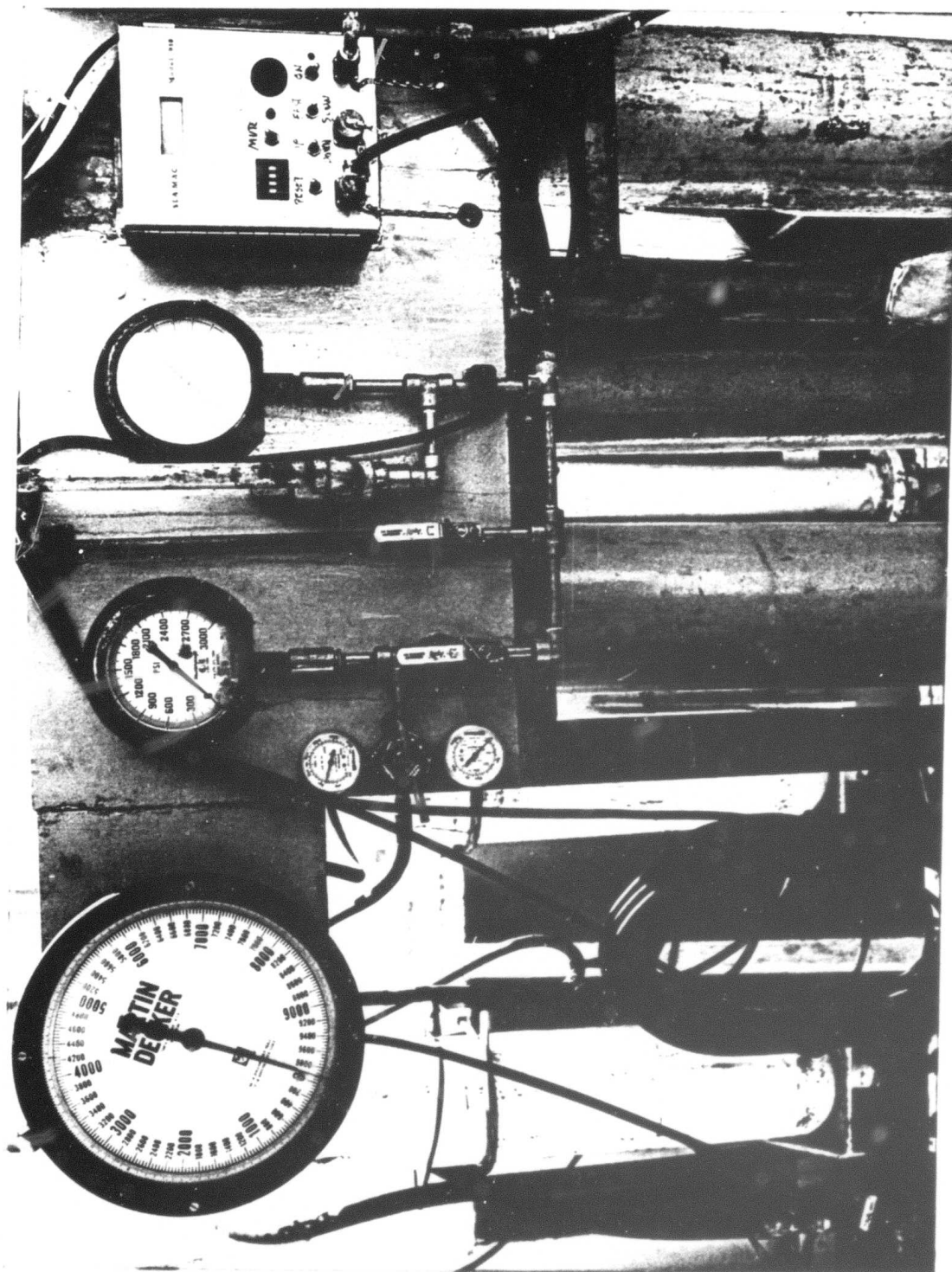


FIGURE 5-6 MSS '82 HC CONTROL PANEL

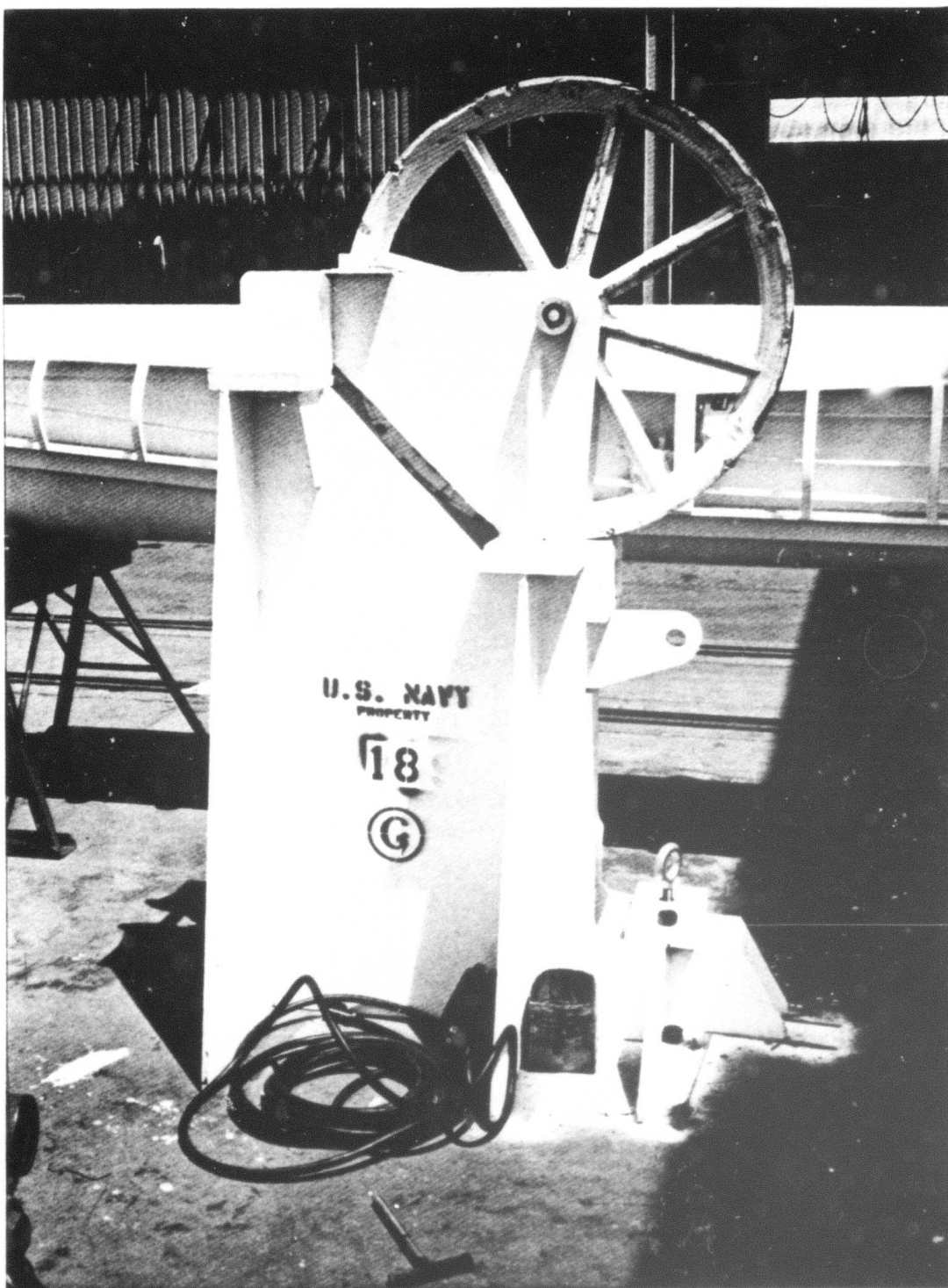


FIGURE 5-7 MSS '82 IDLER SHEAVE WITH STRAIN-SERT

motions caused fluctuations which could not be recorded. A dampened and undampened analog recorder output was provided.

5.3.5 Work Platform

A portable platform was suspended from the bulwark 4 feet above the main deck in the vicinity of the EM Cable. This platform was used for changing out the swivel sheave which was suspended from the A-Frame trolley. It was also used for securing the EM Cable during load transfer required for the BPP Deployment.

5.3.6 Mooring Line

The line for the IRR mooring was stored in a 8' x 8' x 20' steel container. The cable container was installed on the starboard side of the main deck in line with, and athwart ship of, the EM Cable winch. A foundation was made to accommodate the deck camber and to permit water to flow under the cable container.

5.3.7 BIP Carriage Stowage

Three brackets were installed on the port side of the casing rack to stow the BIP carriage housing.

5.4 SUBSEA EQUIPMENT & MODIFICATIONS

5.4.1 Deployment of Subsea Equipment

The primary function of the reentry subassembly was to emplace a functional BIP into a predrilled borehole. The functional steps were:

- o Carry the BIP in a protective enclosure during drill string deployment.
- o Support and position the sonar reentry tool to locate the reentry cone in the same manner as used during conventional DSDP drilling operations.

- o Stab reentry tool into the reentry cone. BIP accelerations must be limited to less than 10 Gs.
- o Release the BIP and allow it to be lowered into the borehole.
- o Allow the EM Cable to run freely into the borehole.
- o Release the EM Cable after the reentry sub is raised and removed from the reentry cone.

5.4.2 Limitations

In order to use existing shipboard equipment and procedures the following dimensional limitations were placed on the design of the reentry sub:

- o The reentry sub must be similar in weight to the normal downhole assembly.
- o The reentry sub must be capable of passing through the existing rotary table and the moonpool guide horn on the Glomar Challenger. This limited the OD of the reentry sub to 31 inches.
- o The reentry sub must be capable of being stabbed into the existing reentry cone and casing. The ID of the cone base must be no more than 24 inches and extend down to 57 inches.
- o The reentry sub stinger must support the 3.75 inch OD sonar reentry tool which is much smaller than the BIP diameter and thus requires a removable support.

5.4.3 Reentry Assembly Modifications

Figure 5-8 shows a layout of the complete Configuration I reentry assembly. Figure 5-9 is a picture of the complete assembly during testing.

During the March 1981 deployment exercise, a potential problem developed when the stinger bent and the reentry stinger cable release slot partially closed at the stinger-cone interface. Although this partial closure did not inhibit operations at the time, the stinger was later redesigned to provide a better interface with the cone-stinger and to improve the section modulus by a factor of 10 thereby reducing the possibility of the EM cable slot inadvertently closing.

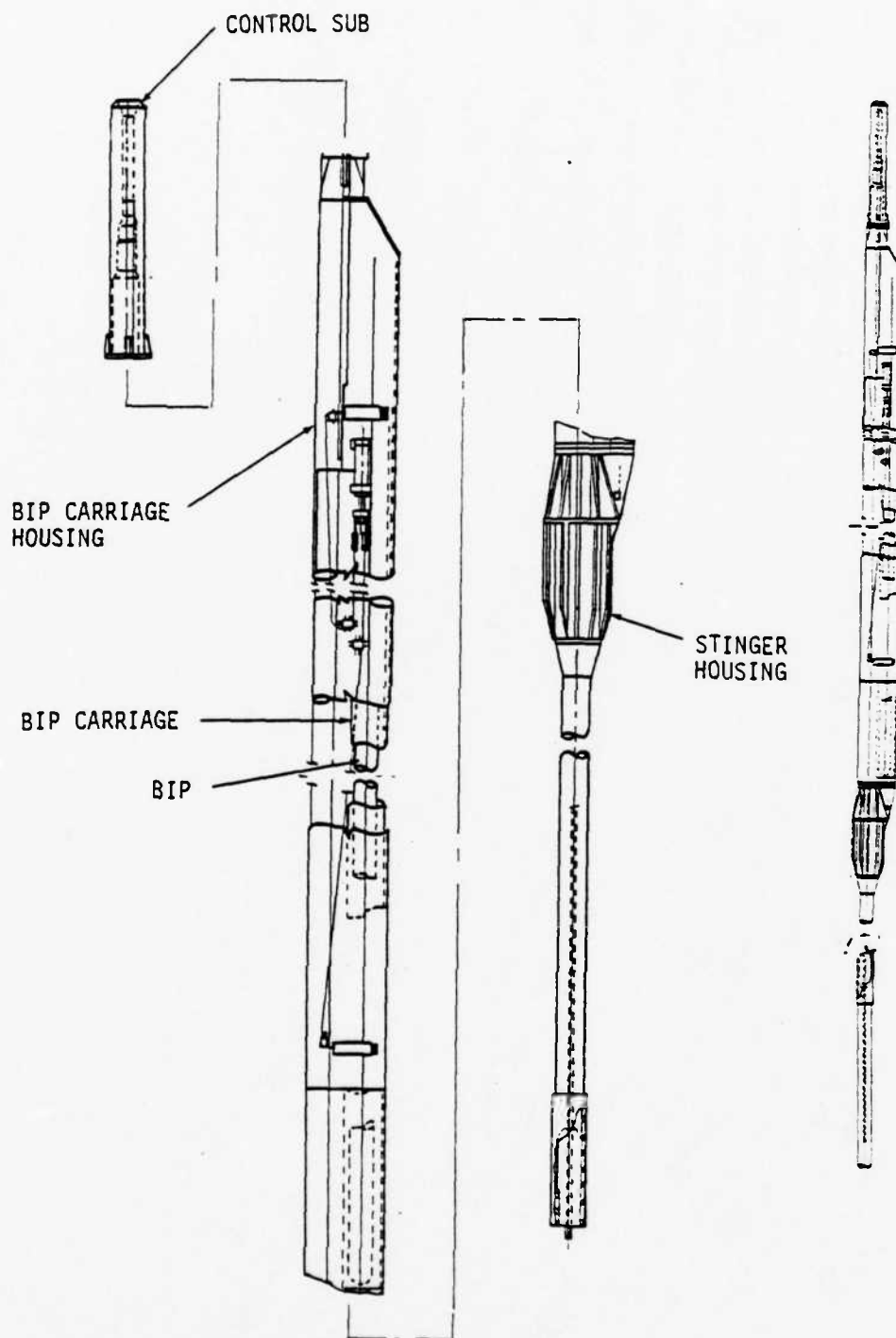


FIGURE 5-8 MSS '82 CONFIGURATION I REENTRY ASSEMBLY



FIGURE 5-9 FIELD TEST OF REENTRY SUB

The bottom of the stinger was also modified to accommodate a sonar centering breakaway plug. This plug is now supported by shear pins capable of supporting the weight of the sonar tool, but which shear when the weight of the BIP is released. Figure 5-10 shows the stinger just prior to test.

The BIP carriage housing was lengthened by 5 feet to accommodate the redesigned longer BIP. The carriage lug shear pin arrangement was also improved for easier installation of the shear pins. The reentry carriage housing is shown on Figure 5-11. The new BIP is equipped with an isolating centering device which kicks-out locking dogs when there is no load on the EM Cable. A shock absorber lined with stainless steel was installed in the BIP carriage to restrain these dogs during the BIP carriage transfer operation when there is no tension on the EM Cable.

Since it is no longer necessary to use the hydraulic plug as a sonar centering device at the bottom of the stinger, the control sub was modified by permanently welding the hydraulic plug/sonar adapter in the control sub position. This centering function is now served by the sonar breakaway plug or centralizer spring. This modification eliminates the trip that was necessary to move the hydraulic plug/sonar adaptor from the bottom of the stinger position up to the control sub position.

The hydraulic plug/sonar adapter was modified to supply a shoulder to support a new Baker check valve. This valve packs off the opening through the control sub when the saltwater hydraulic system is activated.

The sonar sinker bar assembly has an overall length of 69 feet which includes the sonar tool, a centering spring, three lengths of 2 inch Schedule 80 steel pipe and a support sub. The supporting shoulder was also used to support the sonar sinker bar assembly. With the support sub resting on the hydraulic plug/sonar adaptor support shoulder, the sonar tool extends about 6 inches beyond the end of the stinger.

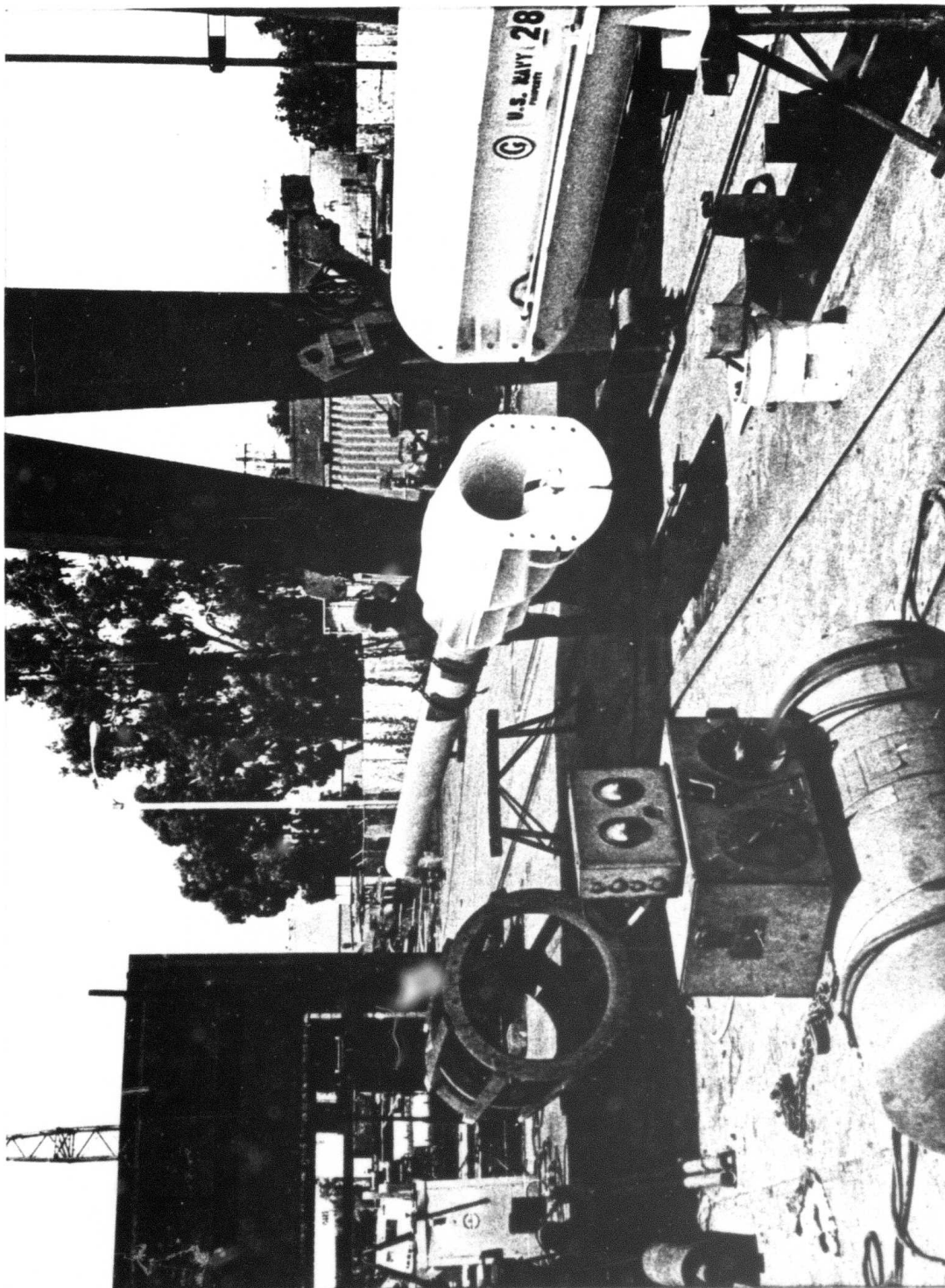


FIGURE 5-10 MSS '82 REENTRY STINGER



FIGURE 5-11 MSS '82 REENTRY HOUSING

5.4.4 Saltwater Hydraulic BIP Transfer System

The following modifications were made to the BIP transfer saltwater hydraulic system:

- o In order to provide a slower and more controlled travel of the cylinders after the pins had sheared, plugs with orifice holes were installed in the outlet ports of the BIP carriage transfer cylinders.
- o A 1,000 psi relief valve was installed at the EM Cable release cylinder to provide a visual indication at the drill floor when pressure was applied to the EM Cable release cylinder. The BIP carriage transfer cylinders operate at a pressure of approximately 2,500 psi.

After the BIP transfer and deployment, the hydraulic pressure is increased to 3,000 psi. This causes a rupture disc to fail and permits the saltwater hydraulic fluid to flow to the EM release cylinder. Where the saltwater reaches the cylinder, the 1,000 psi relief valve will activate causing the pressure in the system to drop to 1,000 psi. The sudden drop in system pressure will be observed on the hydraulic pressure gauge at the drill floor and indicates that the disc has ruptured and the EM Cable release cylinder is pressurized. A check valve is installed at the inlet to this cylinder to retain pressure and insure that the cylinder is in the withdrawn position.

5.4.5 Drill String

Late in the fabrication process it was determined that the new DSDP drill string was under strength and that the ID had been reduced from 4.125 to approximately 3.89 inches. Accordingly, the sonar sinker bar assembly and Baker packer had to be redesigned to accommodate this smaller ID. This also required a modification to the control sub supporting shoulder.

5.5 DEPLOYMENT ANALYSES

Several engineering analyses were performed to assure a successful MSS operation. The following reports and computer programs were prepared.

5.5.1 Reentry Impact Stress Analysis on Modified Reentry Sub Assembly (Reference 4)

This report deals with the stress analysis of the modified reentry sub assembly due to the impulse load which occurs as a result of the reentry impact. The analysis shows that the reentry sub assembly is adequate to withstand the applied impact loads and that all stresses during impact are within the elastic limit of the structure.

5.5.2 Impact Impulse and Mass - Geometrical Characteristics of Modified Reentry Sub Assembly (Reference 5)

This report contains information about the mass-geometrical characteristics of the modified reentry sub assembly. Reentry analysis predicts the impact load applied to the reentry sub during the BIP installation and evaluates the reentry sub motion and its kinematic characteristics due to the reentry impact.

5.5.3 Drill Pipe Stress Analysis (Reference 6)

The drill pipe stresses during the deployment and installation of the BIP into the reentry cone were analyzed. The effect of impact on the drill pipe was considered. Additionally, the drill pipe response due to current, dead weight, waves, ship offset and ship motion is presented. Recommendations are made relative to the bottom assembly, ship heading and ship offset during the reentry.

5.5.4 EM Cable Stress Analysis for MSS Phase IV at Northwest Pacific Site (Reference 7)

This report evaluates the most probable dynamic and combined static and dynamic tension which can be expected in the electro-mechanical

(EM) cable while it is connected to the lower end of the drill string. The results are based on an analytical solution and are verified by computer program SNAPLD^{1/}. Three conservative assumptions were made: 1) No heave compensating system was mounted onboard the ship; 2) All maximum values of ship heave, pitch and roll occur simultaneously and within phase; 3) Both ends of the cable were subjected to simultaneous out of phase excitation the upper end due to ship heave, roll and pitch motion and, the lower end due to stretching of the drill pipe.

The main result of the study was that the BIP could be safely deployed in 12 foot significant, random, head or quartering seas. Recommended minimal tension at the lower end of the EM Cable was established to minimize the probability of cable entanglement.

5.5.5 Stress Analysis of the IRR Deployment at the Northwest Pacific Site
(Reference 8)

This report presents a stress analysis of the critical problems which potentially may occur during the IRR deployment operations. Analytical results were obtained based on conservative assumptions. It was concluded that the IRR system can be safely deployed in a 12 feet significant wave random sea and it is recommended that the ship heading be kept to a maximum of 45° from either the bow or the stern. A-Frame and crane maximum loads are determined and limits on crane boom angles are given.

5.5.6 MSS '82 Northwest Pacific Site Environmental Data (Reference 9)

This report presents predominant significant wave height, wave direction, wind velocity and wind direction for the MSS '82 deployment and initial recovery conditions.

^{1/} SNAPLD is a computer program for simulation of oceanic cable systems, prepared by F.C. Liu, Naval Facilities Engineering Command, January 1982.

5.5.7 MSS Recovery Vessel Ship Motions (T-ATF)

A brief report providing ship motion characteristics of the MSS recovery vessel in various sea states and headings. Computer Programs HANSEL^{2/} and SPECTR^{3/} were used to produce these results.

5.5.8 Computer Programs

In addition to the referenced reports the following computer programs were developed to support the MSS '82 program:

5.5.8.1 CABNAP (Cable Natural Period)

CABNAP is a GMDI developed computer program useful for computing the first three longitudinal natural periods of a continuous cable or bar which is fixed at one end and has a concentrated mass at the other end.

5.5.8.2 CABCON (Cable Configuration)

CABCON is a GMDI developed computer program for computing the deflected shapes of cable systems due to in-plane current forces. This program was developed specifically for the MSS '82 project and was used to determine the ship offset from any point, or mass package, along the cable, knowing cable upper end tension, current forces, and cable lengths and properties.

5.5.8.3 Sensitivity of Martin Decker Load Cell

When the Martin Decker load cell was located at the idler sheave and calibrated with the heave compensator at the midstroke position, errors in tension readings in excess of 20 percent were noted with the heave compensator at extreme positions. When the load cell was attached above the A-Frame sheave the maximum error in tension

^{2/} HANSEL is a computer Program prepared by Naval Ship Research and Development Center, February 1975.

^{3/} SPECTR is a computer program prepared by GMDI, December 1976.

readings, relative to the extreme heave compensator positions, was less than 10 percent. Correction factors were calculated and applied to the load cell readings to compensate for the errors induced by the heave compensator stroke.

SECTION 6.0 - MSS '82 IRR SYSTEM

6.1 BACKGROUND

Late in 1981 NORDA decided that a special recoverable 45-day Data Acquisition Recording System (DARS) would be added to the MSS system. The DARS electronic package, along with the silver-zinc batteries and auxiliary equipment, came to be called the Bottom Processing Package (BPP). To provide recovery and redeployment capability, the Installation, Recovery and Reinstallation (IRR) System was assembled. Naval Civil Engineering Lab (NCEL), Port Hueneme, California, was assigned the responsibility of designing the BPP and IRR equipment.

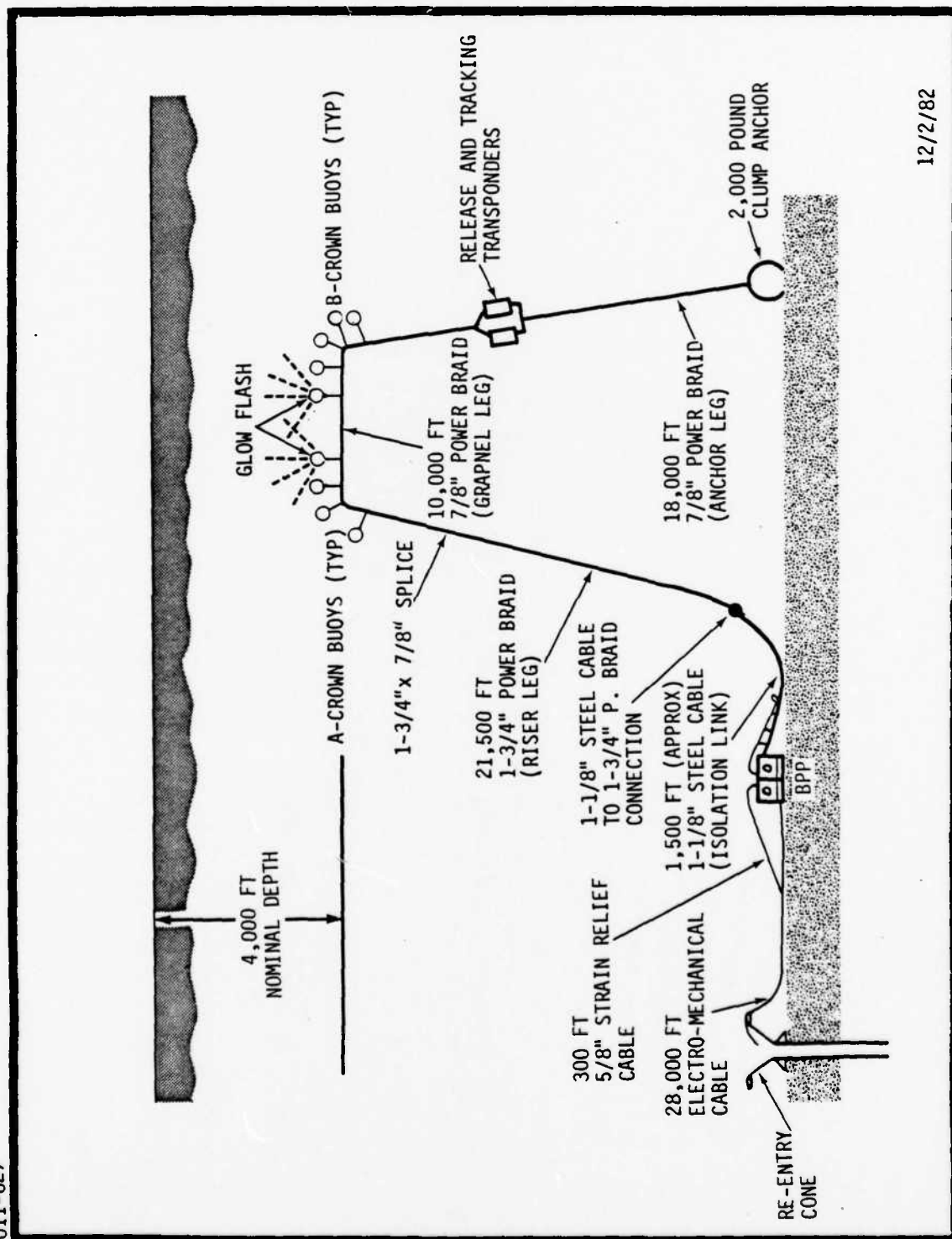
6.2 IRR DESIGN FEATURES (Reference 10)

An important key to a successful MSS operation is the deep ocean cable which is to be used for installation, recovery and reinstallation of the system. The IRR system was the only means of recovering the MSS data and the borehole instrumentation. The design of the IRR system reflected the high value placed on the success of the MSS project. To achieve high reliability, the IRR system had to conform to the following guidelines:

- o The assurance of structural integrity through use of conservative factors of safety applied to static and dynamic loads.
- o Isolation of the BPP from tensions and vibrations of the IRR system. This was accomplished by employing a "soft" cable system.
- o High probability of successful recovery of the BPP by providing a cable system with such flexibility in its range of operation that procedural redundancies are built into the program.
- o High probability of successful offshore operations through simplification of procedures and system component parts.

The MSS/IRR system is shown in Figure 6-1. The IRR is essentially a trapezoidal array with a 10,000 foot length of cable which, if

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FIGURE 6-1 MSS 82 INSTALLATION RECOVERY & REINSTALLATION SYSTEM (IRR)

necessary, can be grappled for recovery of the system. The main requirement of the array, after installation, was that the resultant configuration could be retrieved by using a grapnel hook in the event the acoustic release fails. The main array consisted of braided synthetic line, and a 1,500 foot length of wire rope placed between the BPP and the IRR array. This arrangement acts as an isolation link with its weight providing a reaction to the static and dynamic tensions produced in the structure. The required configuration of the suspended lines was maintained by eighteen 1-1/2 foot diameter glass spheres located at the top and around the corners of the trapezoidal shape. The array was anchored by a 2,000 pound steel ball.

The BPP is an aluminum structure 8'x8'x7.5' high and contains the DARS sphere plus two silver zinc battery spheres as shown in Figure 6-2. The spheres are surplus OBS units rated for 10,000 psi. The BPP weighs approximately 9,400 pounds in air and 4,000 pounds in water. A centerpost attachment connects through a Miller swivel to the riser cable. The EM cable is attached to the bottom of the BPP through a rotating cantilevered arm. An aluminum skirt helps improve holding capability of the BPP in the sediment.

The final design of the IRR system components evolved during the course of the analysis. The performance criteria which most directly impacts the design of the system are:

- o The shape of the installed array.
- o Acceptable behavior of the array in various failure modes.
- o The capability to free-fall the clump anchor while maintaining acceptable load levels and final configuration.
- o The ability to activate the acoustic release and guarantee that some part of the array would surface.

The static shape of the array is defined by the buoys mounted on the array, the weight of the cables and the location of the anchor points. Cables were chosen to be as close to neutrally buoyant as

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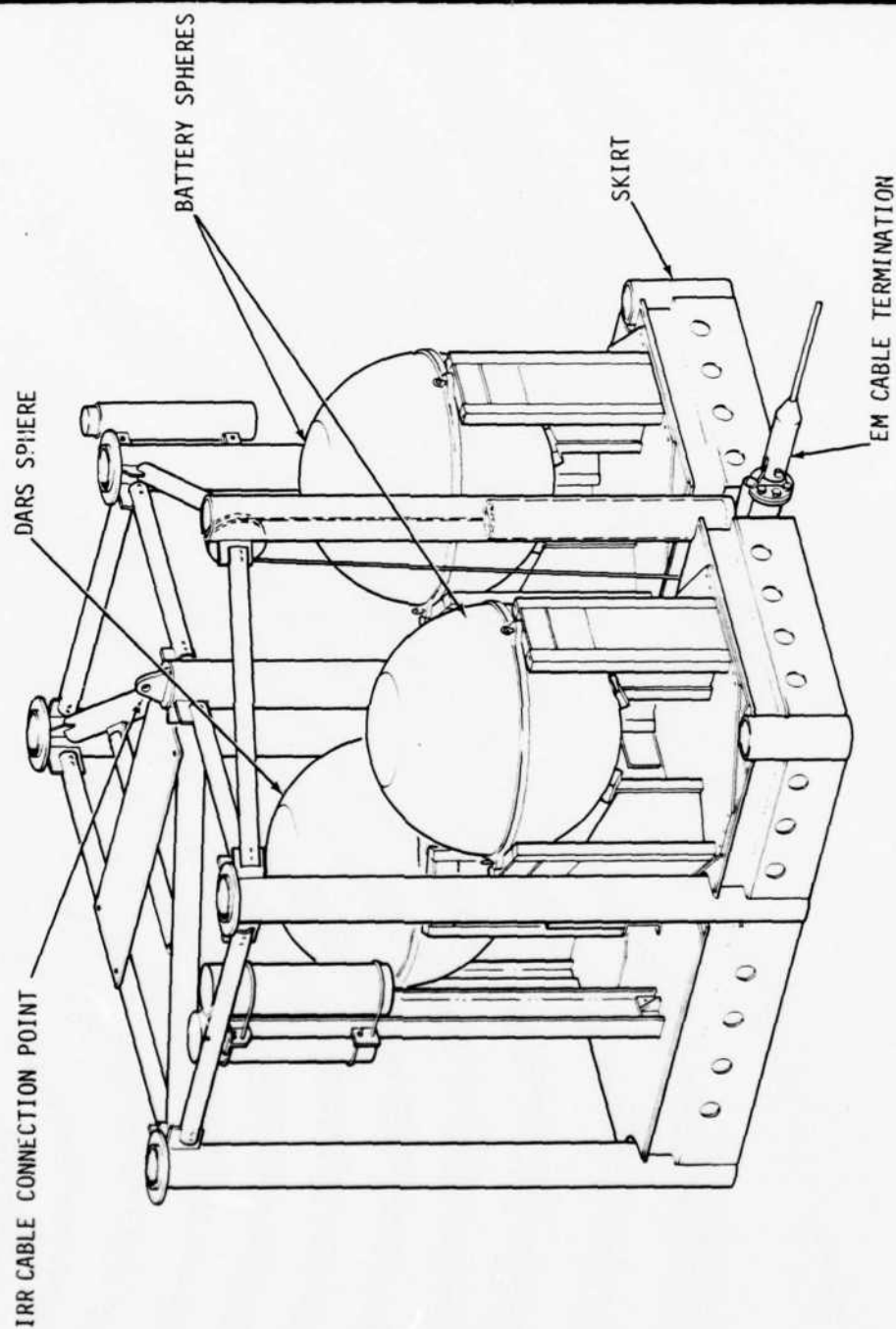


FIGURE 6-2 MSS '82 BPP (BOTTOM PROCESSING PACKAGE)

possible, but buoys have the major influence on the shape. Buoys are selected and distributed along the array in order to maintain an acceptable configuration even if several buoys at any one location fail. The buoys also provide sufficient buoyancy to lift a portion of the array to the surface after the acoustic release has been activated.

The free-fall installation method for the system impacts the size of the isolation link installed between the BPP and the synthetic line. The weight of the clump anchor was optimized to minimize the dynamic load on the isolation link while achieving a trajectory sufficient to reach the intended anchor location.

6.3 IRR INSTALLATION OPERATIONS

After the borehole instrument is installed, the EM cable is payed out from the surface vessel. This operation is analyzed to determine a range of acceptable vessel positions which insures a safe load level during payout. The limiting factors are: (1) zero lateral tension in the cable when laid out on bottom with the stipulation that the cable not double back on itself; (2) a maximum bottom (horizontal) tension of 2,000 pounds, and (3) maximum line tension of 15,000 pounds.

There is a potential for inducing a snap load into the cable while the BPP is being lowered on the riser. As the riser leg is payed out the system passes through a resonant length, (i.e., the length which gives the system a vertical natural period equal to the heave period of the surface vessel). The heave period range of the surface vessel was between 7.5 and 13.0 seconds based upon environmental information provided by the Navy. A model analysis was conducted for the model discussed in Paragraph 5.5.8.1. Natural periods of the suspended array are 7.5 to 13 seconds when the BPP is between 1,500 and 2,500 foot depth. The third vertical mode was the highest mode of vibration encountered in this range.

A dynamic analysis of the system shows no snap loading when the input heave motion corresponds to the resonant period of the system using the most probable vessel heave motions for Sea State 5. However, some load amplification could occur and tensions exceeding 15,000 pounds could be expected. However, this is less than the winch capacity of 20,000 pounds. The absence of severe dynamic amplification at the resonant depth indicates that the system is well damped. The EM cable also acts as a mechanical damper as additional length, and therefore additional suspended mass, is raised and lowered in response to the vessel's heave motion.

The installation of the IRR system is achieved by free-fall of the anchor to a specified target location. This imposed several performance criteria which had to be observed during the free-fall operation: (1) tension at the BPP could not exceed 3,500 pounds vertically or 2,000 pounds horizontally, and (2) the clump had to land outside a 35,000 foot radius from the BPP or several buoys would be on the surface. Reasons for these restrictions were (1) the BPP could not be moved once it was set on the bottom, and (2) all parts of the trapezoidal shaped array had to be submerged.

The maximum drop point is dictated by initial conditions of less than 2,000 pounds tension at the BPP. To provide some factor of safety on this condition the maximum initial tension was set at 1,500 pounds. This puts the drop point approximately 45,000 feet from the BPP which is an extrapolation of the trajectory for a final anchor location of 39,350 feet from the BPP.

6.4 IRR RECOVERY OPERATIONS DESIGN AND PLANNING

During the basic planning stages of the MSS '82 operations an initial IRR leg 40 days after BIP deployment at the Northwest Pacific Site was envisioned. Additionally, a second and third leg to be conducted in 1983 were planned to redeploy the BPP and subsequently recover it. The recovery vessel was to be a US Navy T-ATF fleet tug.

Detailed shipboard handling equipment design and operational planning were conducted for the IRR recovery operations using the T-ATF. A preliminary arrangement and detail design package was submitted to NORDA/MSO. Draft IRR Recovery Operational Procedures were prepared and submitted for review. Unfortunately, all Northwest Pacific Site recovery activities were terminated when the Glomar Challenger failed to complete the borehole.

SECTION 7.0 - MSS '82 MOBILIZATION

A comprehensive logistic support activity was established to assure that the Glomar Challenger mobilization and demobilization was done properly. In particular, the following items were addressed:

- o Shipment of deployment equipment to NCEL, Port Hueneme, California by truck
- o Coordination of IRR procurement activities
- o Shipment of deployment equipment by MSC to Japan
- o Air shipment of electronic type equipment by MAC to Japan
- o Establishment of a field office in Hakodate, Japan
- o Installation of MSS equipment on the Glomar Challenger
- o Removal of MSS equipment from the Glomar Challenger in Yokohama, Japan
- o Air shipment of electronic equipment to the U.S. by MAC
- o Temporary storage of deployment equipment in Japan
- o Coordination with the Glomar Challenger on detail schedule

All logistic support items were successfully accomplished. However, the MAC air shipments required an unusually long time and were difficult to track. Reference 11 is an integrated logistics plan covering the mobilization activities. Three shipyard contracts were involved, one with the Hakodate Dock Co. and two with the NKK shipyard in Yokohama. GMDC negotiated the NKK MSS demobilization task as part of their overall Glomar Challenger drydocking contract.

SECTION 8.0 - CABLE REENTRY CONSIDERATIONS

8.1 OBJECTIVES

One of the objectives of the overall MSS program was to provide an alternative to the drill string deep water BIP deployment technique.

Various "Fly-In" and "Cable Guideline" approaches were evaluated and discussed in the MSS Deployment Phase II Summary Report (Reference 12). Although there are several possible ways to reenter a borehole with a large seismic package, the "Fly-In-On-A-Cable" or Cable Reentry concept appears to offer the greatest potential.

8.2 TECHNICAL DISCUSSION

8.2.1 "Fly-In" Evaluations

Investigation of promising Cable Reentry concepts was initiated in Phase III and continued on a limited basis during Phase IV. This investigation has focused primarily on contacting various Navy, scientific and industrial organizations to review previous related work and determining available technology. Table 8.1 summarizes the Cable Reentry technology status. A great deal of background experience has been accomplished under "Wireline" towed submersible programs.

In any Cable Reentry evaluation, the question of subsea platform propulsion and/or sophisticated control becomes of paramount importance. Past experience strongly indicates that automatically controlled subsea thruster systems require a very long and expensive development program. Thus, development of a simple deployment system relying basically on surface ship maneuvering and incorporating existing short or long base positioning equipment plus deployment package sonar ranging, short or long base. A simple platform thruster pulse augmentation may have to be considered to reduce the required deployment time.

TABLE 8.1

"CABLE REENTRY/WIRE LINE"
STATUS OF PRESENT TECHNOLOGY

ACCOMPLISHMENTS

- o Deep water hovering of small hydrodynamic vehicles has been accomplished.
- o Sonar reentry tool or Long Baseline System (LBS) positioning equipment is available for navigation.
- o Dynamic positioned surface vessel cable provides improved positioning capability.
- o Circling technique has been partially demonstrated.
- o Existing cable dynamic programs are available as analytical tools.
- o Kevlar rope can be utilized as a towing cable.

UNCERTAINTIES

- o Dynamic response of the cable to the motions of a suspended, nonhydrodynamic shaped, platform and to the environmentally induced motions of the surface ship.
- o Effect of ship maneuvering on the submerged platform suspended from a cable.
- o Effect of cable torque on the rotation of the suspended platform. This affects the ability to determine the azimuth orientation of the platform for navigation purposes.

8.2.2 Operational Scenario

The following is a typical operational scenario for a potential MSS Cable Reentry deployment.

A USN AGOR, or equivalent type vessel, will pick-up and recover the DARS/BPP bottom package and the EM cable. After attaching to the EM Cable, the BIP can be pulled from the hole with the winch. The subsea Cable Reentry deployment platform, including the BIP, can be lowered on a special deployment cable. By maneuvering the AGOR, the subsea deployment platform can be positioned over the reentry cone and guided into the reentry cone. The BIP would then be released and lowered into the borehole. After conducting final checks and cementing (if required), the deployment platform would be recovered and the DARS/IRR system or other communication system deployed.

8.2.3 Requirements

The following is a list of some of the general requirements for a Cable Reentry deployment.

- o Stow and handle 30,000 feet of EM Cable, 25,000 feet of deployment cable, plus 20,000 feet of DARS mooring line.
- o Provide vessel with Automatic Station Keeping (ASK) capability.
- o Use thruster augmentation for surface vessel.
- o Provide subsea sonar ranging or Long Baseline System (LBS) platform position reference system.
- o Attain directional stability for subsea platform.
- o Achieve reentry capability into borehole.
- o Provide capability to isolate the BIP from impact shock.
- o Provide subsea release mechanism and control.
- o Avoid cable entanglement.
- o Consider possible motion attenuator (i.e., dragging chain).
- o Consider possible cementing capability.

All of the above capabilities must be integrated into a relatively light weight, easily handleable, configuration. In addition, all actions must be accomplished without entangling the EM Cable and the platform support/sonar cable. The potential for cable entanglement presents a major problem and arises from the requirement for two cables to separate the short term deployment control features from the more restricted 5-year life BIP EM Cable seismic functions. An alternative approach would use one cable and jettison the subsea platform.

8.2.4 Platform Design

The resulting deployment platform may be similar in size and configuration to the drill string type MSS reentry sub but without the BIP offset. Figure 8-1 shows a conceptual type platform which will meet the preliminary requirements stated in Paragraph 8.2.3. The total package will likely weigh between 8,000-26,000 pounds (4,000-13,000 Kg) including the BIP. A separate deployment cable has been provided to support, control and recover the subsea platform. However, the use of an expendable cable and platform may be possible. A sail or vane will probably be required to maintain the deployment platform in desired orientation.

8.2.5 Analyses

A sophisticated dynamic, three dimensional computer program will eventually be required to establish the complex interactions between the ship motions, current conditions and platform hydrodynamic responses. Two known dynamic programs (NCEL and NAVOCEANO) could be adapted for this use. GMDI is independently developing a simplified program to define rough characteristics and establish sensitivity parameters.

8.3 PROPOSED DEVELOPMENT PROGRAM

Although a deep water Cable Reentry deployment appears to be feasible, however, actual data is needed to verify maneuvering

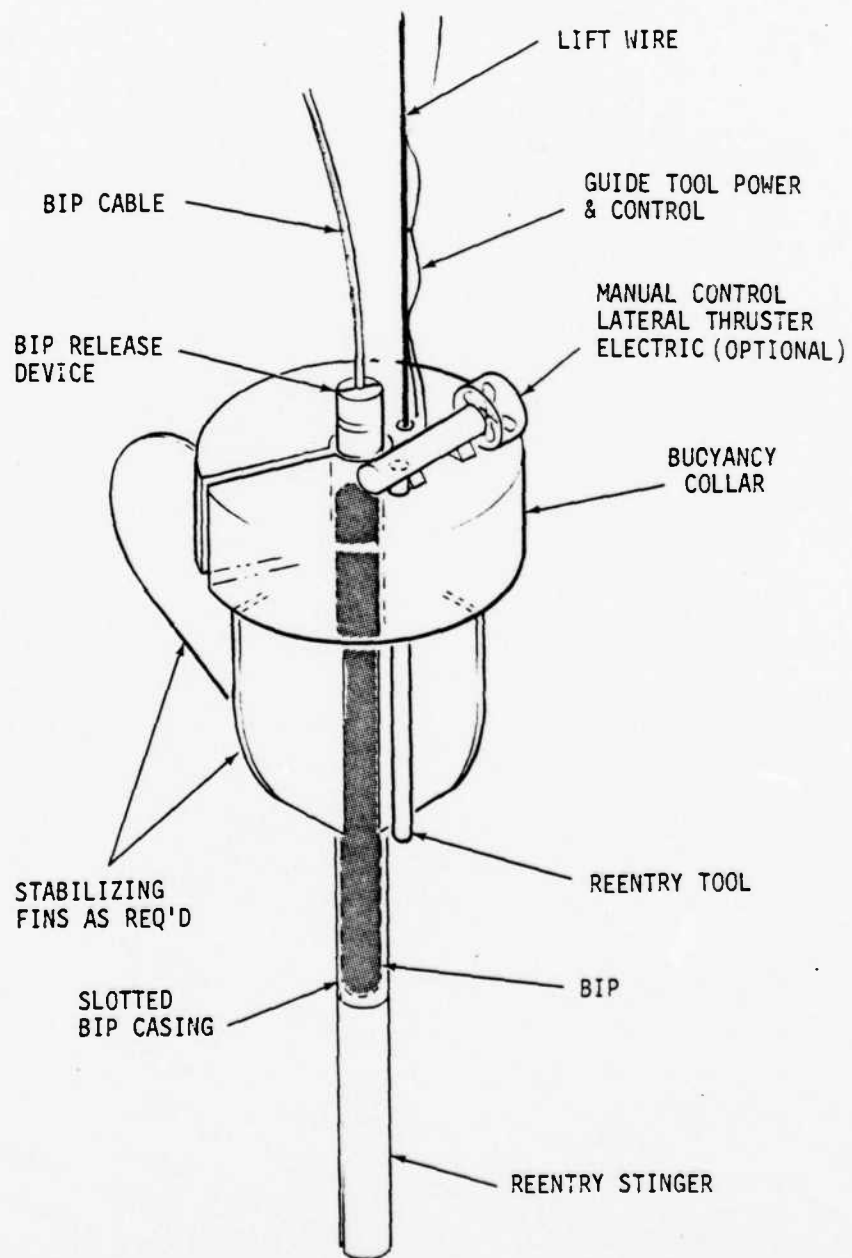


FIGURE 8-1 RETRIEVABLE MSS FLY-IN PLATFORM

capabilities, platform/cable response characteristics, and drag characteristics. A possible developmental test program which could lead to an MSS '85 operation is presented on Table 8.2. The outlined program would utilize the available MSS capabilities and equipment to the greatest possible extent.

TABLE 8.2

STEPS REQUIRED IN FLY-IN DEVELOPMENT PROGRAM

- o Conceptual analysis on maneuvering characteristics.
- o Preliminary design of deployment platform & cable handling system
- o Model testing of deployment platform
- o Shallow water (1,000-2,000 feet) reentry of mockup
- o Two-day deep water test of mockup
- o Deep water testing
- o Final design of deployment system
- o Procurement & test of deployment system
- o Mobilization of deployment system & BIP
- o MSS '85 operation

SECTION 9.0 - MSS DEPLOYMENT PROGRAM PLAN

9.1 INTRODUCTION

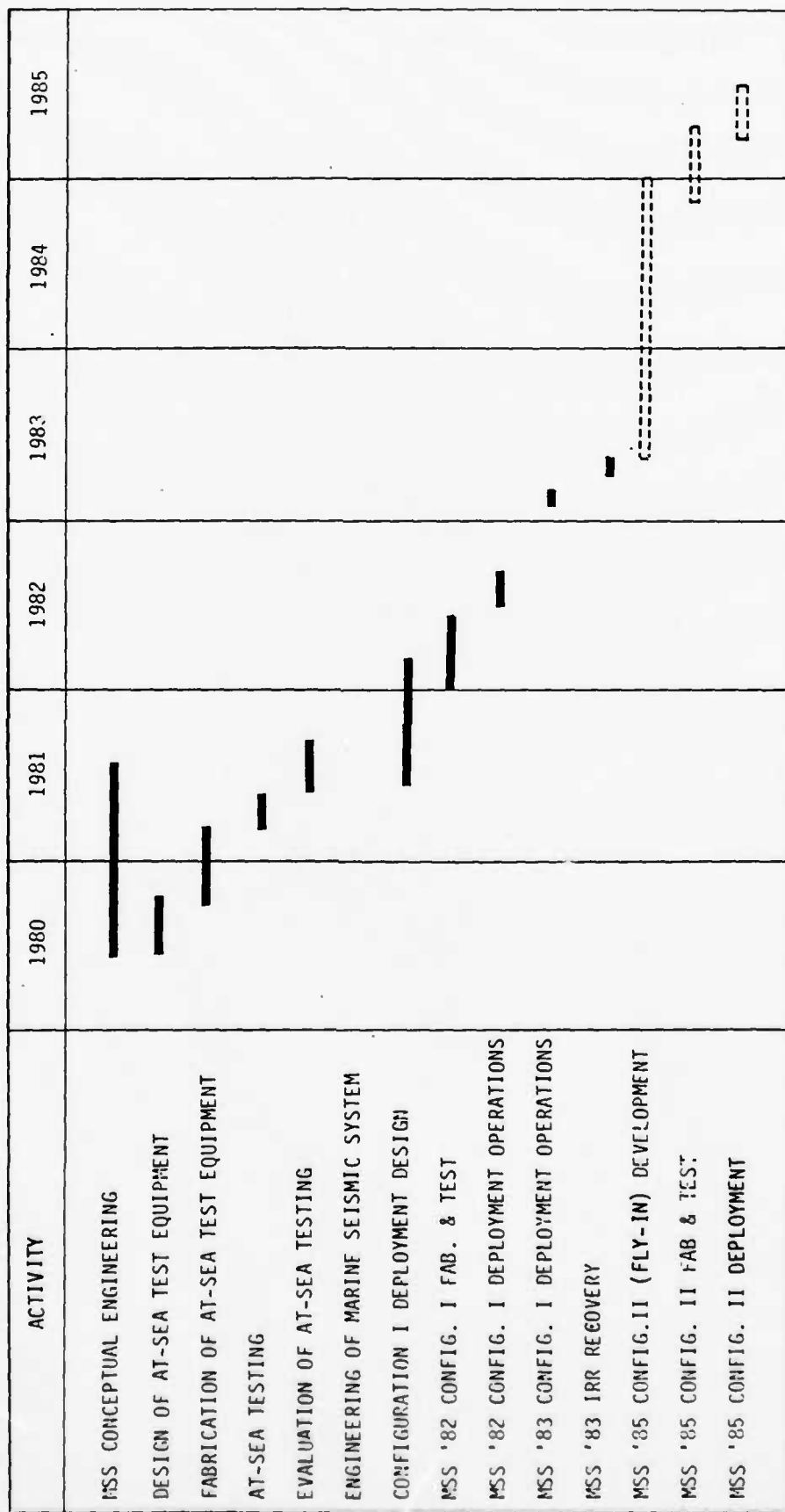
An overall program plan was initially developed during Phase I and was further refined during Phases II, III and IV. The intent of this plan was to guide the technical effort and to evaluate associated costs. The overall program has been modified by the addition of the MSS '83 South Pacific operations. The additional operation delays the tentative Cable Reentry prototype demonstration until 1985. The overall program currently encompasses seven phases covering a period of about four and one-half years. The seven projected phases are:

Phase I	Feasibility Study
II	Analyses, Test Planning and At-Sea-Test Design
III	Test Program and Final Configuration I Design
IV	MSS '82 - Configuration I Mobilization and Operations
V	MSS '83 - Configuration I Mobilization and Operations
VI	Cable Reentry Deployment Development (Projected)
VII	MSS '85 - Configuration II Mobilization and Operations (Projected)

The operational activities encompass drilling the borehole, setting the borehole casing with reentry cone, deployment of the BIP, deployment of the associated mooring, power, control and communication equipment (IRR System), and subsequent recovery of the IRR System.

9.2 SCHEDULE AND WBS

Figure 9-1 shows the scope of the overall program schedule based upon the MSS '82 deployment attempt in the North Pacific area during July-August 1982, the subsequent MSS '83 deployment and recovery operations in the South Pacific and a final prototype demonstration in July-August 1985 at DARPA Northwest Pacific site. Figure 9-2 presents a Work Breakdown Structure (WBS) for all phases of the program.



----- PROJECTED ACTIVITIES

FIGURE 9-1 PROGRAM SCHEDULE

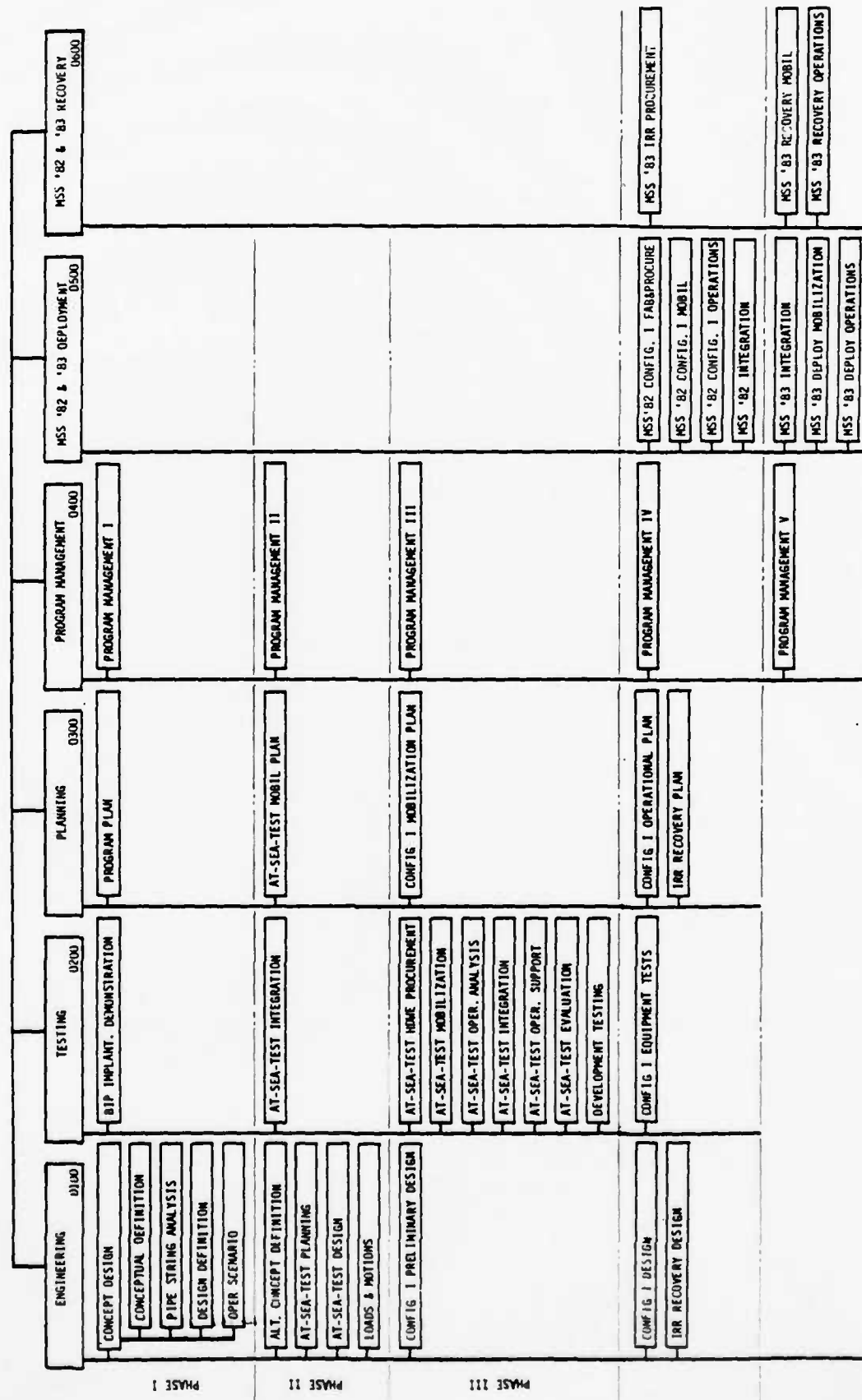


FIGURE 9-2 WORK BREAKDOWN STRUCTURE

0001 0002

9.3 PROGRAM ELEMENTS

The Phase I feasibility study essentially consisted of a conceptual design effort, and initial planning activity, and a Rough Order of Magnitude (ROM) cost estimate. The Phase I report summarized the work accomplished to date in that phase and provided overall guidance for subsequent activities.

The Phase II effort concentrated on the design of equipment for the initial At-Sea-Test demonstration using the Glomar Challenger. This activity started with the development of the necessary test criteria for both At-Sea and onshore development tests. Based upon this criteria, detailed designs for the baseline At-Sea-Test concept were prepared. The baseline design addresses reentry using a drill pipe.

After review by NORDA, the final drawings and equipment specifications were released for vendor selection. In parallel, detailed planning for the At-Sea-Test was initiated including formulation of a fabrication, checkout, and mobilization plan. Detailed cost estimates for the At-Sea-Test equipment were prepared. In addition, a small analytical effort was undertaken to better determine the loads, motions, forces and pipe string stress levels for the drilling, casing installation and reentry operational subphases.

A limited alternate reentry concept evaluation assessed state-of-technology for deep ocean guideline and Cable Reentry deployment approaches. The Cable Reentry platform approach has been tentatively selected for later Configuration II design studies.

Phase III was initiated by the authorization to procure the necessary "At-Sea-Test" equipment. In addition, the detailed test operational procedures plus installation requirements were developed in conjunction with the DSDP Project Office and coordinated with NSF.

The actual MSS '81 At-Sea-Test occurred during late March of 1981. From this test, final verification data concerning impact loadings, cable entanglement and operational procedures were developed. Overall planning for the MSS '82 deployment in the Northwest Pacific was initiated. The final design of the Configuration I deployment equipment was accomplished. In parallel, the preliminary fabrication and mobilization planning for Configuration I deployment has been performed.

Phase IV covered the actual fabrication, assembly and checkout of the specialized MSS '82 Configuration I deployment equipment. The equipment was shipped to Japan for preinstallation checkout. Final Glomar Challenger mobilization and modification procedures were determined and deployment operational procedures were finalized in conjunction with the DSDP Project Office. The shipboard installation of equipment was in Hakodate, Japan. The attempt to deploy the BIP was unsuccessful due to failure of DSDP to emplace the reentry borehole at the designated Northwest Pacific Site. The MSS equipment was removed from the Glomar Challenger in Yokohama, Japan. The electronic equipment was shipped back to the U.S. and the deployment equipment was shipped directly to New Zealand for an attempted Phase V deployment.

Phase V will initially consist of a second Configuration I deployment attempt at a new DARPA designated site in the South Pacific. Mobilization and installation of equipment on the DSDP Glomar Challenger will take place in Wellington, New Zealand. An approximate 35 day leg is projected to emplace a new reentry borehole, deploy the BIP, conduct seismic tests with the Melville, and deploy the IRR System. Demobilization will be accomplished in Papeete, Tahiti. Subsequently, a special recovery leg using the Melville will be mobilized to recover the IRR equipment, remove the DARS, and redeploy the IRR.

It is recommended that development for a MSS Configuration II Cable Reentry Deployment System be initiated in Phase V. This development would be preparatory to a possible MSS '85 prototype system operation

at the DARPA Northwest Pacific site area. The projected development activities would include design evaluations, model basin testing, shallow water testing plus a dynamic analyses, and a deep water demonstration to be accomplished in 1985. The proposed program would coordinate and utilize the available applicable technologies now spread throughout various Navy, scientific and industrial organizations.

SECTION 10.0 - MSS DEPLOYMENT PROGRAM COST EVALUATION

The actual and projected costs of the overall MSS Deployment Program have been reevaluated based on the present understanding of overall MSS criteria. The costs are broken down by phase and by major activity.

10.1 COST EVALUATION

A cost estimate for the overall MSS Deployment Program has been updated and is presented in Table 10.1. The cost summary has been organized into a matrix to show costs by phase and by major activity. The Phase V costs are derived from the revised Phase V proposal (Reference 4) recently submitted to NORDA which covers only the first six months of FY 1983.

Actual costs for the March 1981 At-Sea-Test reentry demonstration are presented in Table 10.2. Actual costs for the MSS '82 deployment operations are presented on Table 10.3.

The cost associated with definition of a possible Configuration II deployment must wait until the overall scope of the program and the extent of GMDI's involvement is more clearly defined.

TABLE 10.1

MSS DEPLOYMENT PROGRAM COST PROJECTION

ACTIVITY	I Jan-Jun 1980	II Jun-Sep 1980	III Oct-Sep 1981	IV Oct-Sep 1982	V* Oct-Mar 1983	V** Apr-Sep 1983	VI** Oct-Sep 1984	TOTAL
Engineering	\$59,000	120,200	71,700	256,500	--	165,000	250,000	\$ 922,400
Testing (including At-Sea-Test)	--	17,200	1,151,000	100,900	--	231,000	850,000	2,350,100
Planning	15,400	15,100	37,100	114,700	--	--	40,000	222,300
Program Management	11,200	35,900	108,800	148,700	88,600	40,000	130,000	563,400
Deployment - MSS '82	--	--	--	792,300	--	--	--	792,300
Deployment - MSS '83	--	--	--	--	804,400	--	--	804,400
TOTALS	\$85,600	188,400	1,368,600	1,413,100	893,200	436,000	1,270,000	\$5,654,900

*Covers costs for proposed first six months of GFY 1983 (Reference 4).

**NOM estimate for Cable Reentry development.

NOTE: Figures displayed are representative of the broad categories listed.

They are not intended to portray the negotiated contract, or total actual cost to the government by detailed work breakdown structure.

TABLE 10.2

ACTUAL COSTS FOR THE MSS '81 AT-SEA-TEST DEMONSTRATION
MARCH 1981

ACTIVITY	COSTS
At-Sea-Test Equipment Design	\$ 345,300
At-Sea-Test Equipment Procurement	369,300
At-Sea-Test Planning	21,800
At-Sea-Test Integration	86,400
At-Sea-Test Mobilization and Operations	348,200
Shore Testing	84,700
Evaluation	35,800
TOTAL	\$1,291,500

- NOTES: 1. Excludes Glomar Challenger costs
2. Excludes Program Management

Figures displayed are representative of the broad categories listed. They are not intended to portray the negotiated contract, or total actual cost to the government by detailed work breakdown structure.

TABLE 10.3

ACTUAL COSTS FOR THE MSS '82 CONFIGURATION I DEPLOYMENT SYSTEM

ACTIVITY	COSTS
Configuration I Design	\$ 238,500
Configuration I Procurement	244,200
Operation Planning	443,100
Equipment Test	100,900
Mobilization and Demobilization	303,200
Operations	99,500
Integration	145,400
TOTAL	\$1,574,800

- NOTES: 1. Excludes Glomar Challenger costs
2. Excludes Program Management
3. Includes IRR System

Figures displayed are representative of the broad categories listed. They are not intended to portray the negotiated contract, or total actual cost to the government by detailed work breakdown structure.

SECTION 11.0 - REFERENCES

1. GMDI Report RPT-006-007, "Marine Seismic System At-Sea-Test" Rev 0, dated 10/9/81.
2. GMDI Report MSSA01-001; "Marine Seismic System - Deployment Phase III," Rev 0, dated March 1982.
3. GMDI Report MSSA02-SYS-P002, "Deployment Operational Procedures," Rev 0, dated 6/7/82.
4. GMDI Report MSSA02-STR-R001, "Reentry Impact Stress Analysis of Modified Reentry Subassembly," Rev 0, dated 11/16/81.
5. GMDI Report MSSA02-STR-R002, "Impact Impulse and Mass Geometrical Characteristics of Modified Reentry Assembly," Rev 0, dated 1/4/82.
6. GMDI Report MSSA02-STR-R003, "Drill Pipe Stress Analysis," Rev 1, dated 4/23/82.
7. GMDI Report MSSA02-STR-R004, "Electro-Mechanical Cable Stress Analysis." Not Released.
8. GMDI Report MSSA02-STR-R005, "Stress Analysis of the IRR Deployment At Northwest Pacific Site." Rev 0, dated 6/22/82.
9. a) GMDI Report MSSA02-SYS-R001, "Environmental Data (August-September)," Rev 1, dated 3/25/82.

b) GMDI Report MSSA02-SYS-R002, "Environmental Data (October)," Not Released.
10. Western Instrument Report, "Design and Analysis of the MSS/IRR System," prepared for NCEL, dated April 1982.

11. GMDI Report MSSA02-SYS-P003, "Integrated Logistics Plan for Mobilization MSS '82 - Phase IV - Development Program," Rev 0, dated 5/25/82.
12. GMDI Report RPT-001-005, "Marine Seismic System Deployment - Phase II," Rev 0, dated 09 January 1981.
13. GMDI Proposal 0782-01-031, "Phase V MSS Deployment System," Rev 2, dated 13 October 1982.

MSSA02-SYS-P001
REV 2
MAY 1983

MARINE SEISMIC SYSTEM PROGRAM

MSS '82 TEST PLAN SYNOPSIS

26 FEBRUARY 1982

PREPARED BY:

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APPENDIX A

MSSA02-SYS-P001, "TEST PLAN SYNOPSIS"



**GLOBAL MARINE
DEVELOPMENT INC.**

Newport Beach, Calif.

REVISION RECORD

REV	DATE	AUTHORIZATION	CHANGE DESCRIPTION	PAGES AFFECTED
0	2/26/82	R. Wallerstedt	Initial issue for NORDA review and comment.	A11
1	7/23/82	R. Wallerstedt	Sect. 1.0 Minor editorial corrections Sect. 2.0 Added OBS Systems Sect. 3.1 New site position Sect. 3.2 Revised Borehole Characteristics Sect. 4.0 Minor revisions to schedule Fig. 4.1 Updated Program Schedule Table 4.1 Added critical milestones Sect. 5.0 Minor revisions Sect. 6.0 Update instrumentation Sect. 8.0 Added two HIG personnel Sect. 9.0 Added new information on support vessels	1 3 4 4 5 6 7 8 9 12 13
2	5/31/83	R. Wallerstedt	Sect. 1.0 Minor word changes Sect. 4.0 Table 4.1 Typos Sect. 6.0 Typos Sect. 9.0 Typos	1,2 7 9 13

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SECTION 1.0 - OBJECTIVES

The primary objective of MSS '82 Program is to conduct a proof-of-principle demonstration of the deep water borehole seismic Borehole Instrumentation Package (BIP) concepts.

Specifically the program will:

- o obtain Northwest Pacific site specific subseabed seismic data
- o demonstrate deepwater BIP seismic capabilities deployed within a borehole
- o demonstrate deepwater deployment of the Bottom Processing Package (BPP) using an Installation Recovery and Reinstallation (IRR) system
- o verify Data Acquisition Recording System (DARS) seabed recording instrumentation capability
- o demonstrate IRR installation and recovery techniques
- o deploy and recover Hawaii Institute of Geophysical (HIG) Ocean Subbottom Seismometer (OSS)
- o deploy and recover eleven Ocean Bottom Seismometer (OBS) units

In order to prove the effectiveness of the BIP, as installed in the seabed substrate, seismic data, both short-period and mid-period, will be measured.

Real-time data will be taken over a five day period and recorded data will be taken over a forty-five day period.

The baseline concept, wherein the BIP is lowered on the end of the drillstring, will be used to demonstrate the capability of placing the BIP into the borehole.

Once the BIP is emplaced into the borehole, the Navy supplied AGOR surface support vessel will be used to conduct vertical reflection surveys at 3.5 and 12.0 kHz, seismic surveys using the 30KJ sparker, and slant range explosive testing.

The HIG/OSS will be used in conjunction with several Ocean Bottom Seismometric (OBS) units to confirm the data. The HIG/OSS will be lowered through the drillstring directly into the uncased borehole.

The BPP package, HIG's OSS system, and some of the OBS units will be recovered over the next 30 to 60 days using an IRR recovery operation especially designed and mobilized for this purpose. The BIP and EM cable will be left at the site.

Dynamic loads associated with deployment of the DARS and subsurface mooring equipment will be recorded. In 1984 the MSS '82 BIP may be replaced by an instrument of more advanced design if wire guideline techniques are developed and proved. Data relevant to this subsequent MSS '84 operation will be a secondary objective of the MSS '82 operations.

SECTION 2.0 - ORGANIZATION RESPONSIBILITIES

The following is a list of the various operation areas, components and/or activities and the corporate organization which has responsibility for them.

Program Management	NORDA
Test System Integration & Technical Coordination	GMDI
Test Site Selection	NORDA/DSDP
Current Meter Measurements	NORDA
Support Ship - (Deployment)	NORDA
Support Snip - (Recovery)	NORDA
Explosives	NORDA
Reentry Deployment Equipment	GMDI
BIP Tests Package	GEOTECH
Data Acquisition & Recording System (DARS)	GOULD
Pressure Vessels for DARS & Batteries	GOULD
EM Cable	GEOTECH
EM Winch	NORDA
Seismic & Acceleration Data Monitoring Equipment	GEOTECH
<u>Glomar Challenger</u> Modifications	GMDI/GMDC
Test Procedures	GMDI
Mobilization/Demobilization Logistic Support	GMDI
MSS Calibration Experiment	NORDA
IRR Mooring Hardware & Subsurface Buoy Design	NCEL
IRR Mooring Hardware & Subsurface Buoy Procurement	NORDA/GMDI
BPP Structural Design	NCEL
BPP Fabrication and Assembly	GOULD
BPP Recovery	GMDI/NCEL
OSS System and Associated Equipment	HIG
OBS System and Associated Equipment	HIG/OSU

SECTION 3.0 - SITE CHARACTERISTICS

3.1 SITE LOCATION

The proposed tests will be accomplished in the Northwest Pacific utilizing a new borehole and reentry cone to be installed by the Glomar Challenger as part of the Deep Sea Drilling Program (DSDP). The primary site is located at 43°55.62'N, and 159°47.7'E. Typical characteristics of the proposed sites are:

- o Water Depth: 18,000 feet (5,488 m)
- o Sediment Depth: 1,132 feet (345 m)
- o Basalt Penetration Depth: 63-165 feet (20 to 50 m)

The sediment is expected to be a silica-calcareous clay with volcanic admixture.

3.2 BOREHOLE

The new borehole will have a diameter of 10 inches and will be drilled to a depth of approximately 1,295 feet below the seabed and will penetrate at least 150 feet into the basalt layer. A 16 inch diameter by 200 foot long conductor casing will be installed in the upper unconsolidated sediment area. The central portion of the borehole will be cased down to approximately 1,130 feet using 11-3/4 inch casing. The bottom basalt region will not be cased. The HIG/OSS will be installed in an uncased test core near the primary borehole.

3.3 REENTRY CONE

A standard DSDP reentry cone with casing hanger and casing to basement will be emplaced. The upper reentry cone will be approximately 16 feet in diameter and 20 feet high.

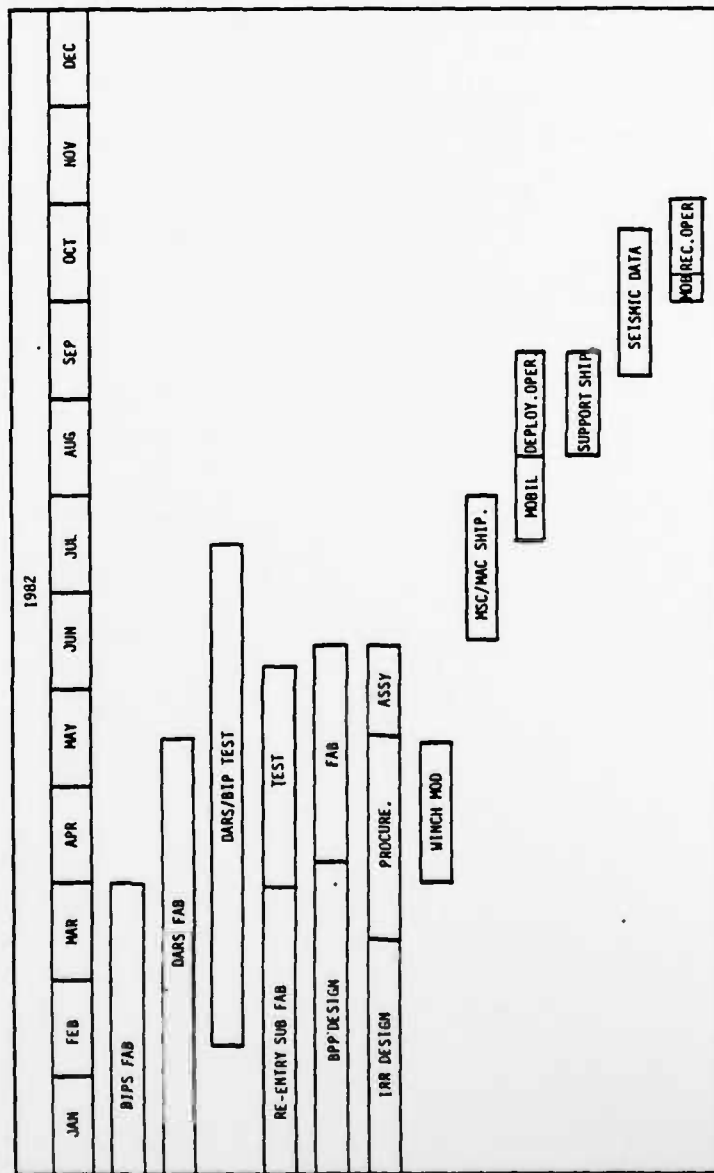
SECTION 4.0 - SCHEDULE

The proposed test is tentatively scheduled for the period between late August to early September 1982, and will coincide with DSDP leg #88 using the Glomar Challenger. The Glomar Challenger will depart Hakodate, Japan on approximately 21 August 1982 and return to Yokohama, Japan on 23 September 1982. Total estimated on-site time for the Glomar Challenger is approximately 19 days in support of the MSS Test. Figure 4-1 is the current schedule. The IRR recovery operation will be conducted between 1 October 1982 and 1 November 1982. An integrated test schedule will be provided and updated twice monthly.

Table 4.1 summarizes the remaining critical schedule milestones.

MSS (MARINE SEISMIC SYSTEM) '82 PROGRAM SCHEDULE

DATE 1 AUGUST 1982



011-005

FIGURE 4-1 MSS '82 PROGRAM SCHEDULE

TABLE 4.1
RECAPITULATION OF CRITICAL MSS '82 MILESTONES

<u>DESCRIPTION</u>	<u>DATE</u>
AGOR DESTIEGUER LEAVES SAN DIEGO FOR ADAK	4 AUG
GLOMAR CHALLENGER ARRIVES HAKODATE	18 AUG
RECOVERY SHIP DESIGN PACKAGE SUBMITTED	20 AUG
DESTIEGUER LEAVES ADAK	20 AUG
GLOMAR CHALLENGER LEAVES HAKODATE	21 AUG
GLOMAR CHALLENGER ARRIVES AT SITE	25 AUG
DESTIEGUER ARRIVES AT SITE	25 AUG
BOREHOLE COMPLETED	31 AUG
BPP DEPLOYED	2 SEP
SEISMIC TESTING COMPLETE	7 SEP
IRR DEPLOYED	9 SEP
GLOMAR CHALLENGER LEAVES SITE FOR JAPAN	16 SEP
DESTIEGUER LEAVES SITE FOR ADAK	18 SEP
IRR RECOVERY PROCEDURES (PRELIM) ISSUED	20 SEP
MISS EQUIPMENT UNLOADED, YOKAHAMA	24 SEP
MSS (AGOR) EQUIPMENT UNLOADED AT ADAK	24 SEP
IRR FIRST LEG RECOVERY PROCEDURES ISSUED	30 SEP
T-ATF NARRAGANSETT AVAILABLE JAPAN	1 OCT
T-ATF LEAVES JAPAN	8 OCT
BPP RECOVERED AND IRR REDEPLOYED	21 OCT
T-ATF ARRIVES JAPAN	26 OCT

SECTION 5.0 - EQUIPMENT

The baseline system involves lowering of the BIP on the end of the drillstring and consists of the following at-sea-test equipment:

TABLE 5.1
BASELINE EQUIPMENT REQUIREMENTS

EQUIPMENT	RESPONSIBILITY	REMARKS
BIP Reentry Test Packages (2)	GEOTECH	NORDA Supplied On-board
EM Cable	GEOTECH	
Reentry Tool (Sonar & Readout Console)	DSDP	
Reentry Sub	GMDI	
(Includes two Impact Stingers, one Release Mechanism Reentry Sub and Plus a Control Manifold)		
Shipboard Test Console (STC) Van	GEOTECH	Navy Supplied
EM Cable Winch	NORDA	
MSS Deployment Equipment	GMDI	
Reentry Cone & Casing	DSDP	
Deployable Current Meter or Shear Probes	NORDA	
OBS Seismic Packages	OSU/HIG	
ASK Beacons	DSDP	
BPP Package Incl. DARS and Batteries	GOULD	
IRR Mooring Cable & Subsurface Buoys	NCEL	
Underwater TV Camera	NORDA/GMDI	
DARS Checkout Console	GOULD	DOE Supplied
Seismic Package	HIG	
Bottom Package and Recovery Equipment	HIG	
ATNAV System, Transponders, Acoustic Releases	NCEL/OCEI	

SECTION 6.0 - TEST DATA

6.1 SEISMIC IN-HOLE DEMONSTRATION (120 HRS REAL-TIME)

- o 3-Channel Short-Period Seismic Sensor
- o 3-Channel Mid-Period Seismic Sensor
- o Backup (Vertical) Short-Period Seismic Sensor
- o OBS Comparative Data (11 OBS units planned)
- o BIP State-of-Health Instrumentation:
 - 4 Temperature Sensors
 - 1 Pressure Transducer
 - 1 Input Voltage Monitor
 - 12 Regulated Voltage Monitors
 - 1 Reference Voltage Monitor
 - 1 Selectable Voltage Monitor
 - 4 Calibration Status Indicators
 - 3 Digital Monitors, Including:
 - . 1 Subframe Counter
 - . 1 Command Arrival Time
 - . 1 Master Status Word
 - 3 Digital Words to Recognize Feedback and Signal Clipping

6.2 DARS SEISMIC IN-HOLE DEMONSTRATION (45 DAYS RECORDED)

- o 3-Channel Short-Period Seismic Sensor
- o 3-Channel Mid-Period Seismic Sensor
- o OBS Comparative Data (3 OBS)
- o State-of-Health Instrumentation:
 - 3 Leak Detectors
 - 2 Tilt Detectors
 - 4 Temperature Sensors
 - 1 Pressure Transducer
 - 1 Humidity Sensor
 - 1 Primary Battery Monitor

- 2 Secondary Battery Monitors
- 9 DC/DC Power Monitors
- 2 ADC Status Monitors
- 7 Spare Channels
- 1 Hydro Acoustic Calibration
- 1 Real Time Clock

6.3 REENTRY DEMONSTRATION

- o Ship Stationkeeping Characteristics
- o Shock Impact
- o Current Profile with Depth
- o Cable Tension

6.4 LOWERING IN BOREHOLE DEMONSTRATION

- o Release BIP Acceleration Characteristics
- o BIP Lowering Velocity
- o Surface Cable Payout
- o Lowering Cable Tension

6.5 IRR DEPLOYMENT

- o Ship Stationkeeping Characteristics
- o ATNAV Control Characteristics
- o Cable Tension
- o Glomar Challenger Wave Response

6.6 IRR RECOVERY & REDEPLOYMENT

- o BIP Status
- o Cable Tension
- o HIG's OSS System and Omit OBS Units
- o T-ATF Stationkeeping Characteristics
- o BPP Package (DARS)
- o ATNAV Control Characteristics
- o T-ATF Wave Response

SECTION 7.0 - SPECIAL CONSIDERATIONS

- o The high strength drillstring is an expensive and long lead procurement item. Responsibility for the drillstring lies with DSDP.
- o The BIP will not be cemented into the borehole.
- o Severe weather and currents are typical in this general site area.

SECTION 8.0 - ACCOMMODATIONS FOR TEST PERSONNEL

Accommodations will be provided for the following numbers of at-sea-test personnel:

GEOTECH	3
GOULD	3
GMDI	3
HIG	2
NORDA	<u>1</u>
	12

SECTION 9.0 - SUPPORT VESSELS

The USN AGOR support vessel, USNS DeSteiguer, will be on station during the 19 day deployment period. A USN T-ATF support vessel will be used for the recovery operation.

APPENDIX B

MSSA02-SYS-S001, "SYSTEM INTERFACE AND REQUIREMENTS SPECIFICATION"

MSSA02-SYS-S001

REV 2

MAY 1983

MARINE SEISMIC SYSTEM PROGRAM
MSS'82 AT-SEA-TEST
BASELINE DEPLOYMENT SYSTEM INTERFACE & REQUIREMENTS

26 FEBRUARY 1982

PREPARED BY

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Newport Beach, Calif.

REVISION RECORD

REV	DATE	AUTHORIZATION	CHANGE DESCRIPTION	PAGES AFFECTED
0	2/26/82	R. Wallerstedt	Initial release for NCRDA review and comment.	All
1		R. Wallerstedt	Sect. 1.0 Minor word changes Sect. 4.1 New site position Sect. 4.2 New borehole characteristics Sect. 4.3 Remove ATNAV transponders from reentry cone New Figure 4.1 Table 4.1 Revised deployment limits Table 4.4 Revised current profile Figure 5.1 Revised operational activity schedule Figure 6.2 New BIP schematic Sect. 7.3.1 Revised cable lengths Sect. 7.3.7 Revised cable dimensions Sect. 7.4.3 Added new sheave Sect. 8.1.5 Revised BPP weights Figure 8.1 Added BPP Configuration dwg Figure 8.3 Revised Table 8.1 Added BPP Configuration dwg Sect. 9.8 Revised mooring line size Sect. 10.3 Added new ATNAV array descript. Sect. 11.1 Added USNS De Steigner Sect. 11.2 TATF has been committed EDC RELEASED	1 4 4 4 5 6 13 15 18 23 24 24 27 28 31 32 34 35 36 36
2	5/31/83	R. Wallerstedt	Sect. 3.0 Minor Word Changes Sect. 4.0 Minor Word Changes	3 4, 7

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SECTION 1.0 - OBJECTIVES

The objective of this Interface Specification is to define the performance and interface requirements for the Borehole Instrumentation Package (BIP) reentry equipment, shipboard equipment, STC, BPP, IRR mooring equipment, and Recovery Ship Handling Equipment for the MSS '82 System demonstration. The deployment is to be performed at a new site in the Northwest Pacific utilizing the Glomar Challenger. Recovery and reinstallation of the BPP will be accomplished using Navy supplied vessels.

SECTION 2.0 - REFERENCES

- o MSSA01-SYS-POOL "MSS '82 Test Plan Synopsis" Rev 1 dated July 1982
- o Reentry Cone Assembly
- o Glomar Challenger Plans (D-377-A002, -A003 & -A004)
- o Reentry Assembly Control Dwg MSSA02-D002
- o BIP/Reentry Sub with Stinger Control Dwg MSSA02-D001
- o Glomar Challenger MSS At-Sea-Test Interface Dwg
- o BIP Control Dwg 990-53100-0102
- o BIP Assembly Dwg
- o At-Sea-Test Mobilization Plan, GMDI Report
- o MSS At-Sea-Test Operational Procedures, GMDI Report
- o EM Cable Winch Dwg (Revised)
- o BPP Assembly Dwg
- o IRR Installation, Recovery and Reinstallation System Control Dwg

SECTION 3.0 - TEST OBJECTIVES

The test objectives are to:

- o Provide MSS seismometer borehole
- o Demonstrate the baseline BIP drill string deployment techniques in deep water
- o Measure seismic signal and noise within a deep sea borehole
- o Record 5 days of real-time seismic data
- o Deploy the BPP and associated IRR mooring system
- o Record 45 days of seismic data (DARS)
- o Recover BPP and redeploy EM cable
- o Deploy HIG seismometer and associated recovery equipment
- o Deploy 11 OBS units
- o Recover HIG seismometer
- o Recover OBS units

SECTION 4.0 - GENERAL REQUIREMENTS

4.1 SITE

The proposed tests will be accomplished in the Northwest Pacific utilizing a new borehole and reentry cone to be installed by the Glomar Challenger during DSDP Leg #88. The site is located at 43°55.6'N, 159°47.7'E. Typical characteristics of the proposed sites are:

- o Water Depth: 5,488 m (18,006 ft)
- o Sediment Depth: 345 (1,132 ft)
- o Basalt Penetration Depth: 20 - 50M (63 - 165 ft)

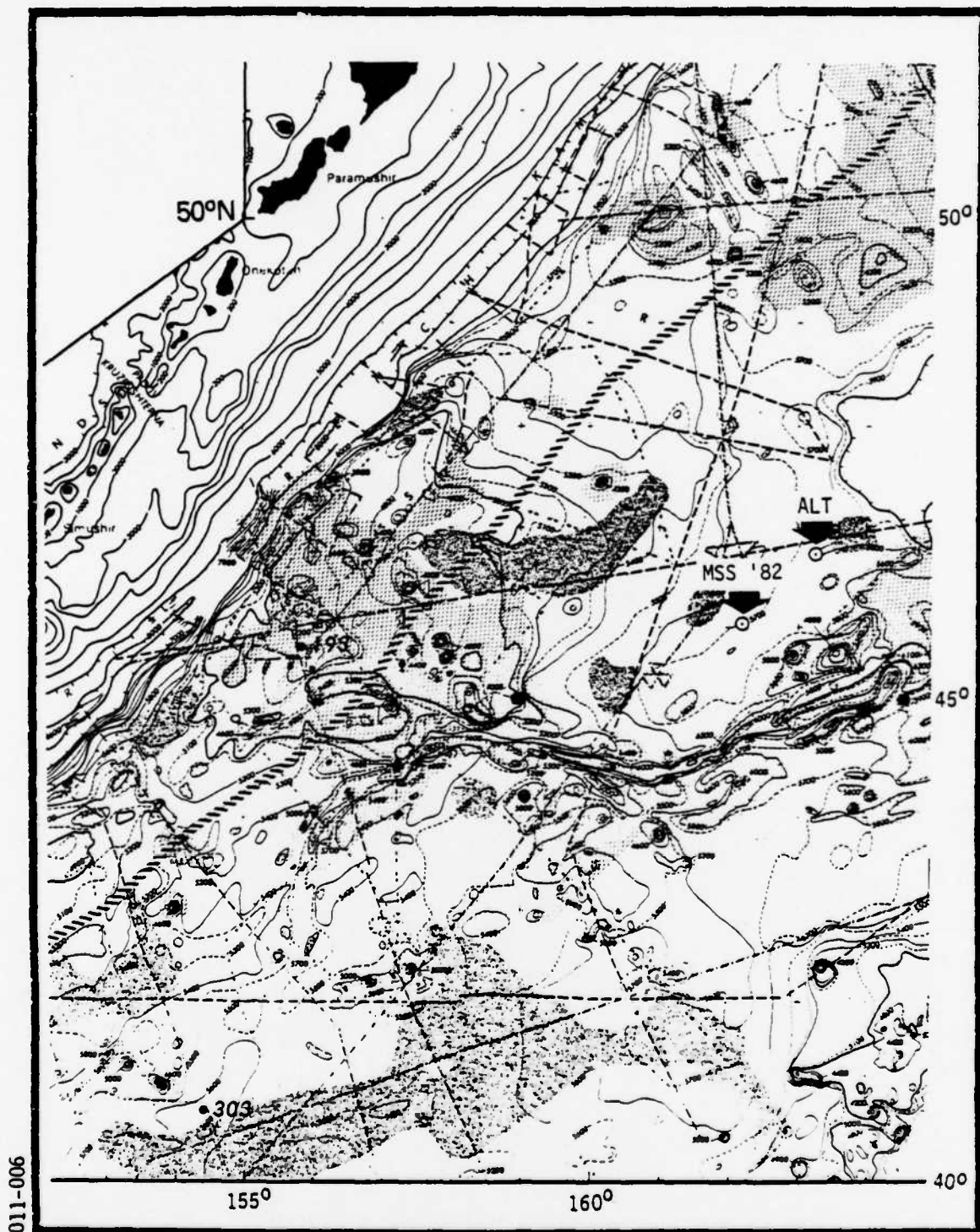
The sediment is expected to be a silica-calcareous clay with volcanic admixture. See Figure 4-1 for general topography of bottom.

4.2 BOREHOLE

The new borehole will have a diameter of 10 inches to a depth of approximately 1,295 feet below the seabed and will penetrate at least 150 feet into the basalt layer. A 16-inch diameter by 200 foot long conductor casing will be installed in the upper unconsolidated sediment area. The central portion of the borehole will be cased down to approximately 1,130 feet using a 11-3/4 inch casing. The bottom basalt layer will not be cased.

4.3 REENTRY CONE

A standard DSDP reentry cone with casing hanger will be emplaced. The upper reentry cone will be approximately 16 feet in diameter and 20 feet high. See Figure 4-2 for the general configuration of the reentry and the cone will be modified as necessary to protect the EM Cable.



CREDIT FOR THIS DATA GOES TO JAMES GREEN, NORDA REPORT #31

FIGURE 4-1 MSS '82 SITE BATHYMETRY

0006-054

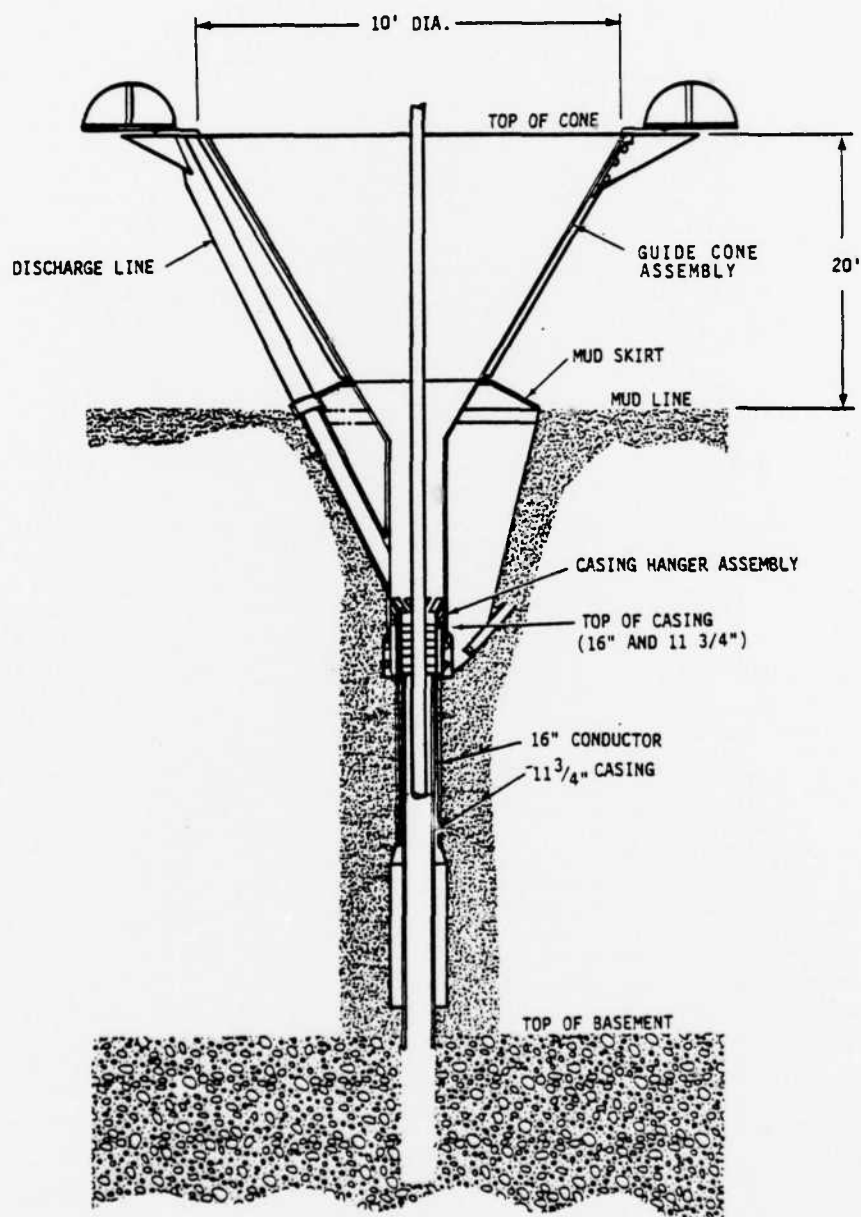


FIGURE 4-2 MSS '82 BOREHOLE/REENTRY CONE CONFIGURATION

4.4 REENTRY VELOCITY

The maximum allowable drillstring reentry velocity is 10 ft/sec.

4.5 PRESSURE

All subsea equipment designs must meet an operating pressure of 10,000 psi.

4.6 OPERATIONAL CRITERIA

The conditions under which operations must be conducted are listed in Table 4.1.

4.7 SITE WEATHER & SEA CONDITIONS (From NORDA Technical Report 31)

4.7.1 General Weather

Summer anticyclonic air circulation is controlled by a high pressure cell centered about 40°N, 150°W. Wind direction is synonymous with atmospheric circulation, whereas surface currents are generally caused by Ekman transport and geostrophic flow.

Paths for low pressure fronts generally move from southwest to northeast, slightly to the north of the proposed sites.

4.7.2 Winds

Projected maximum and typical wind conditions are shown in Tables 4.2 and 4.3. Prevailing winds are from the West.

TABLE 4.1

GLOMAR CHALLENGERTENTATIVE MSS DEPLOYMENT LIMITS

(See Sheet 2.0 of MSS '82 Operational Procedures)

OPERATION	SEA STATE	SIGNIFICANT WAVE (FEET)	WIND SPEED (KNOTS)
HANDLING MODE	5	12	24
DRILLING MODE	6	22	30
REENTRY MODE (CONE AND CASING)	4	8	20
REENTRY MODE (BIP (DEPLOY)	5	15	25
POSITIONING	7	?	40
KEELHAULING (REENTRY CONE)	4	8	20
BPP OVERSIDE DEPLOYMENT	3	5	16
IRR LINE DEPLOYMENT	5	15	25
ULTIMATE PITCH/ROLL ANGLE $\pm 9^{\circ}$			
SAFETY PITCH/ROLL ANGLE $\pm 7^{\circ}$			
DRILL STRING TENSILE LOAD 600,000 LBS (22,500 FT PIPE STRING - CALM)			
MAXIMUM BENDING STRESS (25,000 PSI)			
MAXIMUM DYNAMIC AXIAL STRESS (17,000 PSI)			

TABLE 4.2

WIND AND WAVE CLIMATIC DATA FOR MSS DRILL SITE

(162° 08'E, 45° 41'N) 47-49°N, 161-164°E

	AUG	SEPT	OCT
WIND DIRECTION AND SPEED			
WAVE DIRECTION AND HEIGHT			
TROPICAL CYCLONE CHARAC- TERISTICS	<p>65. CONSTANCY - 12 HR VECTOR RESULTANT MEAN STORM SPEED DIVIDED BY 12 HR SCALAR MEAN SPEED AND MULTIPLIED BY 100. A MEASURE OF CONFIDENCE IN DIRECTIONAL PERSISTENCE.</p> <p>04. AVERAGE NUMBER OF TROPICAL CYCLONES PER 5° SQUARE FOR THE PERIOD OF RECORD.</p>	99	99
		02	03

REFERENCE: U.S. NAVY MARINE CLIMATIC ATLAS OF THE WORLD, VOL II, NORTH PACIFIC OCEAN
REVISED 1977 NAVAIR 50-1C-529

TABLE 4.3
MSS '82 WEATHER SUMMARY

	DEPLOYMENT PERIOD (AUGUST)	RECOVERY PERIOD (OCTOBER)
Typical Conditions:	Sea State 4 or Less	Sea State 5 or less
Predominant Winds:	Below 24 Knots	Below 36 Knots
Probability of Exceeding:	4 FT Wave 95% 8 FT Wave 50% 12 FT Wave 20% 20 FT Wave 5%	4 FT Wave 85% 8 FT Wave 30% 12 FT Wave 10% 16 FT Wave 3% 20 FT Wave 2%

4.7.3 Waves

Projected maximum and typical wave conditions are shown in Tables 4.2 and 4.3. Predominate waves are from the west.

4.7.4 Surface Currents

The site lies north of the eastward flowing warm water of the Kuroshio currents and east of the southward flowing Kamchatka (Oyashiro) current. Summer surface currents are shown in Figure 4-3. Expected surface current is 1.0 knots, with a maximum projected current of 2 knots. Table 4.4 lists the design current and maximum profiles. Current direction is typically from the Northwest.

TABLE 4.4
DESIGN CURRENT PROFILE

DEPTH BELOW SURFACE (METERS)	CURRENT SPEED (KNOTS)	
	TYPICAL	PROBABLE MAXIMUM
0 (Surface)	1.00	2.00
100	.30	.60
300	.20	.40
1,000	.10	.20
3,000	.05	.10
5,700 (Seabed)	.05	.10

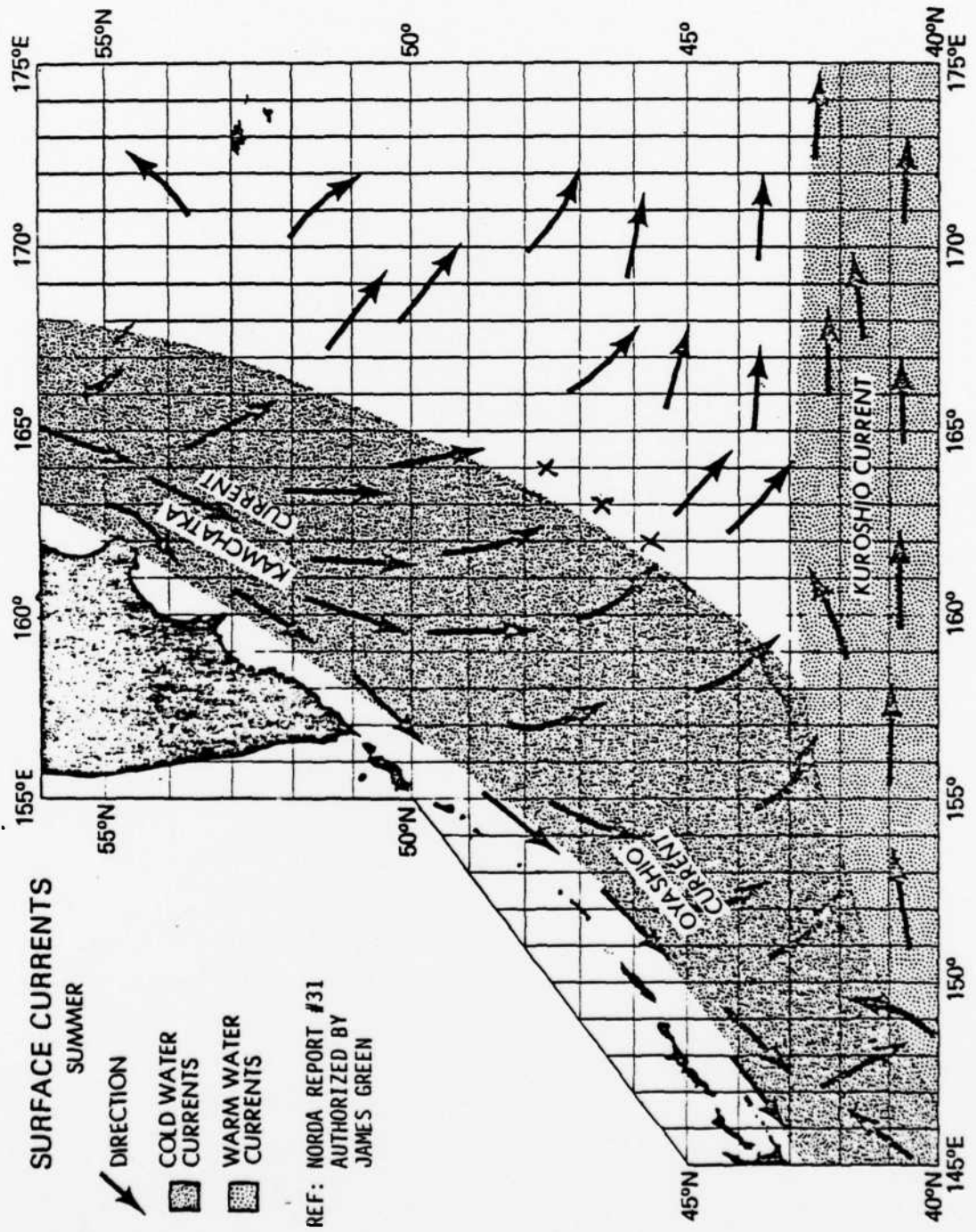


FIGURE 4.3 SITE SURFACE CURRENTS

0006-055

SECTION 5.0 - SCHEDULE REQUIREMENTS

5.1 TEST PERIOD

The deployment and test period will begin in late August 1982 and extend through early September 1982. The Glomar Challenger is scheduled to leave port on 24 August 1982. The initial recovery period will be in October 1982.

5.2 TEST TIME

The available time scheduled for actual MSS operations is 30 days. The required on-station time is 19 days which does not allow for weather delays or major malfunctions. As many as five days of in-hole continuously sampled and recorded seismic data will be obtained prior to deployment of BPP/DARS equipment. Table 5.1 shows the time allotted for each on-site activity.

TABLE 5.1
MSS '82, DSDP LEG 88, TIME ESTIMATES

ACTIVITY	TIME REQUIRED (HOURS)	CUMULATIVE	
		HOURS	DAYS
1 Depart Hakodate			
2 Transit to Site	100	100	4.2
3 Locate Site & Position on Beacon	6	106	4.4
4 Pick Up R/E Cone, 16 inch Casing & RIH	24	130	5.4
5 Wash in Cone & Drill 14 7/8 inch to 400 M	10	140	5.8
6 Round Trip/Pick Up 400 M 11-3/4" Casing	36	176	7.3
7 R/E Set 11-3/4" Casing & Cement	8	184	7.7
8 Round Trip to Pick Up Coring Assembly	30	214	8.9
9 R/E & Core 50 Meters Basement	24	238	9.9
10 Pull Out of Hole	12	250	10.4
11 DARPA - Make Up Carriage Assembly	8	258	10.8
12 RIH	15	273	11.4
13 Run EDO Tool & R/E	6	279	11.6
14 Release BIP & Run to Bottom	4	283	11.8
15 Pull DP From Hole			
16 Real Time Data Recording	120	403	16.8
17 Connect EM Cable to DARS	3	406	16.9
18 Check System	8	414	17.3
19 Launch DARS & Run System to Seafloor	8	422	17.6
20 Launch No. 1 Buoy System	3	432	18.0
21 Deploy 10,000 ft. Power Braid	4	429	17.9
22 Launch No. 2 Buoy System	3	432	18.0
23 Deploy 28,000 ft. Power Braid	4	436	18.1
24 Make Up & Test Anchor System	3	439	18.3
25 Launch Anchor	4	443	18.5
26 OSS - Move Vessel - Pick Up BHA & RIH	12	455	18.9
27 Wash +400 M to Basement	6	461	19.2
28 Core 20 M Basement and Drop Bit	10	471	19.6
29 Run HIG Tool & Test	6	477	19.9
30 Strip DP From Hole	18	495	20.6
31 Splice/Redhead/Keehaul Wire	12	507	21.1
32 Attach & Deploy Recording Pkg & Rope	8	515	21.5
33 Move Vessel & Pick Up HPC, BHA, RIH	12	527	21.9
34 HPC to Refusal (twice)	100	627	26.1
35 POOH - Magnaflux BHA	18	645	26.9
36 Steam to Yokohama	123	768	32.0
37 Arrive Yokohama			

SECTION 6.0 - BIP TEST PACKAGE

6.1 CONFIGURATION

The BIP test package will be 8 inches diameter maximum by 34-1/2 feet long. The package will have a spherical shaped bottom nose. GEOTECH drawing Figure 6-1 defines the general outline of the BIP test package. Two screwed-in attachment plugs are available for shipboard handling.

6.2 WEIGHT

The maximum weight of the test package will be 3,300 pounds. This weight includes fairings, pressure vessels and all instrumentation and ballast.

6.3 POWER

Input power requirements will be 25 W at 150 VDC.

6.4 EM CABLE TERMINATION

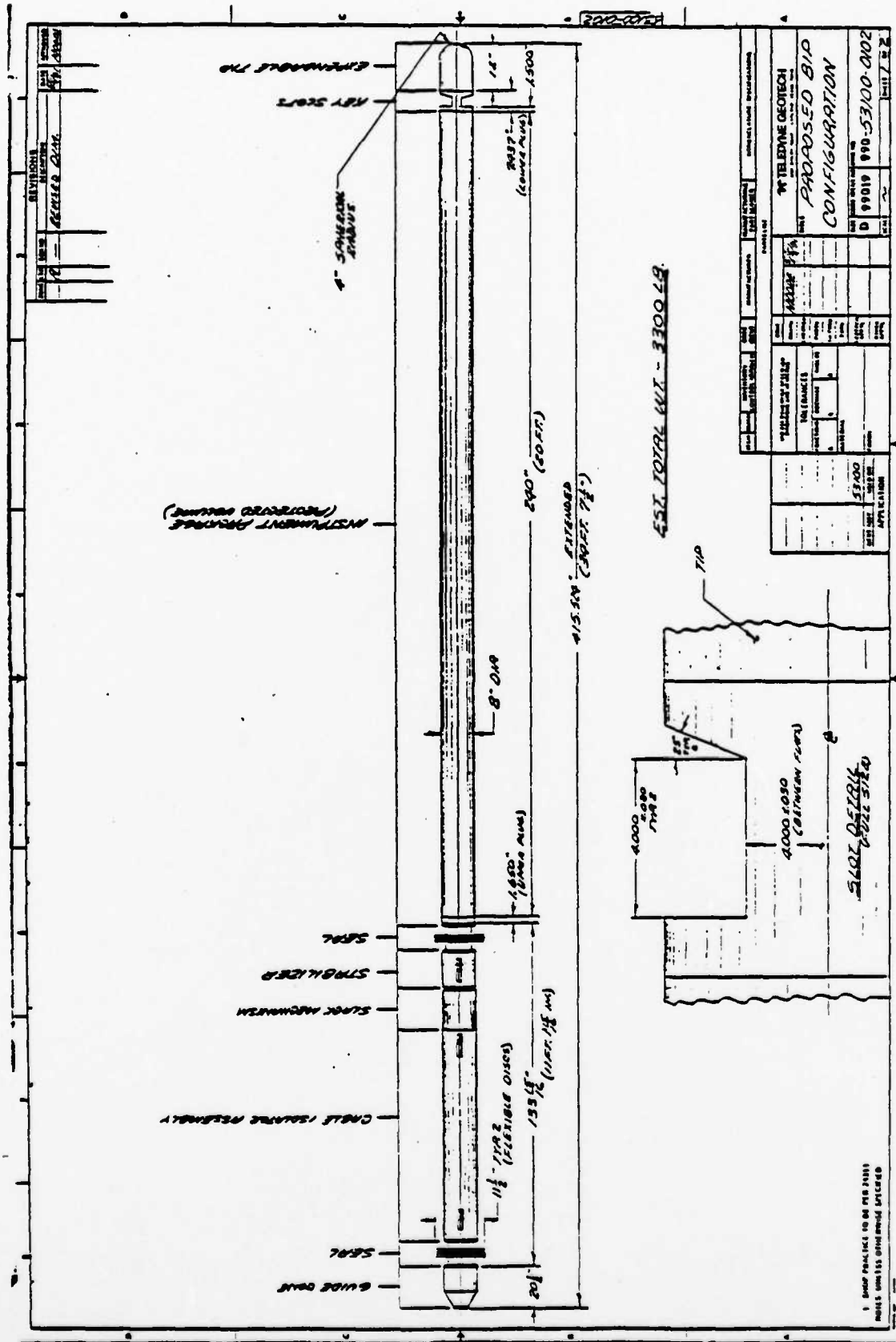
A watertight termination compatible with an armored coax conductor cable will be utilized. The mechanical connector will be a pinned connection. The electrical terminal is a watertight connection. A sealant will be provided in the termination area.

6.5 INSTRUMENTS

Figure 6-2 depicts a schematic of the BIP.

The following instruments will be provided in the BIP:

- o 3-Channel Short Period Seismic Sensor
- o 3-Channel Mid-Period Seismic Sensor



MSS BIP DEPLOYMENT MODE TELEMETRY/BIP CONTROLLER

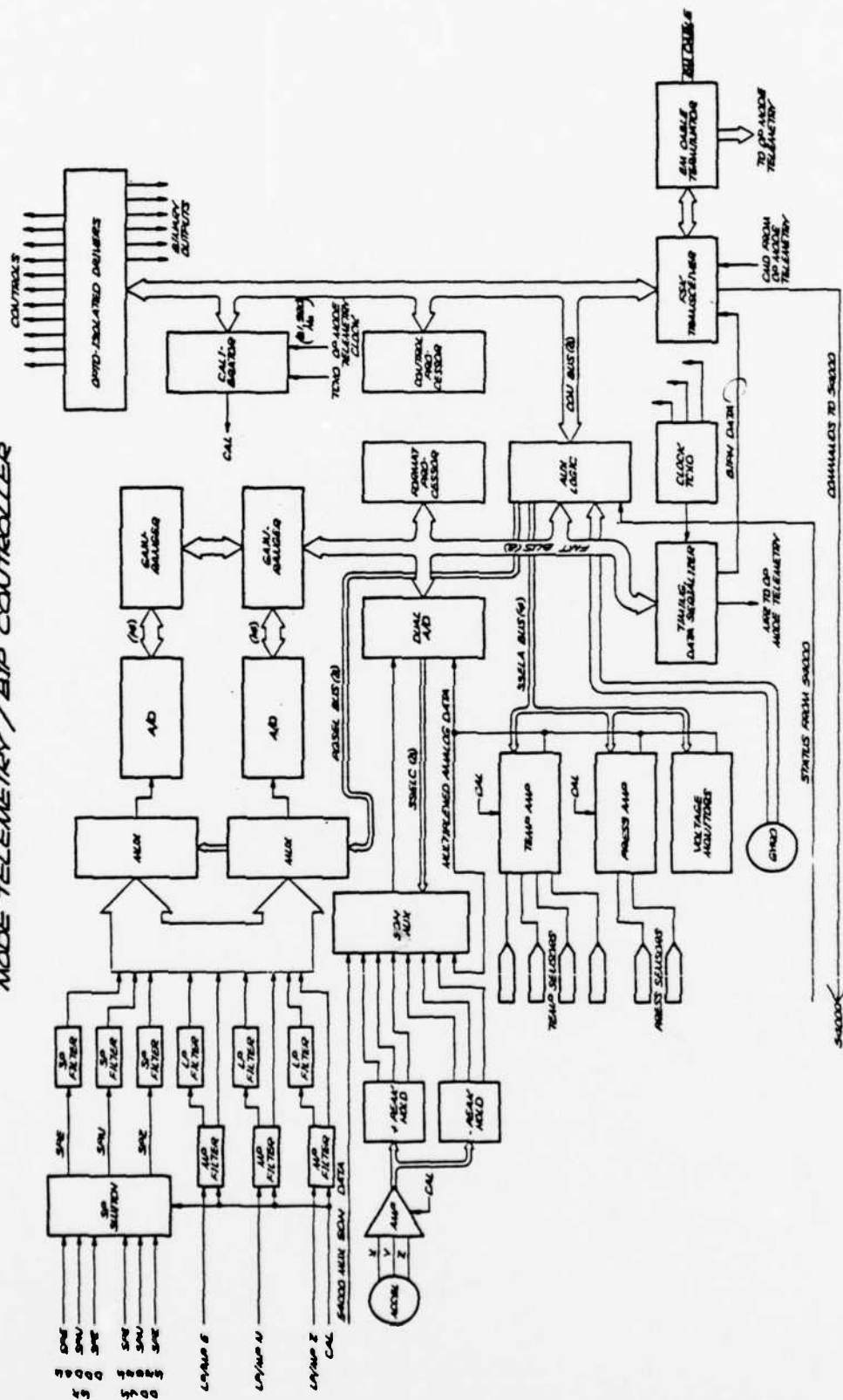


FIGURE 6-2 MSS '82 BIP SCHEMATIC

- o Back-up (Vertical) Short Period Sensor
- o State-of-Health Instrumentation
- o 3-Channel Acceleration Sensor

6.6 DATA MONITORING

To be supplied at a later date.

6.7 EM CABLE

The BIP EM Cable will be a specially constructed 0.692 inch diameter armored coax cable. Approximately 30,000 feet are to be provided. This allows for current, stationkeeping allowance, plus slacking off during data recording. Refer to Figure 6-3 for design data on the cable.

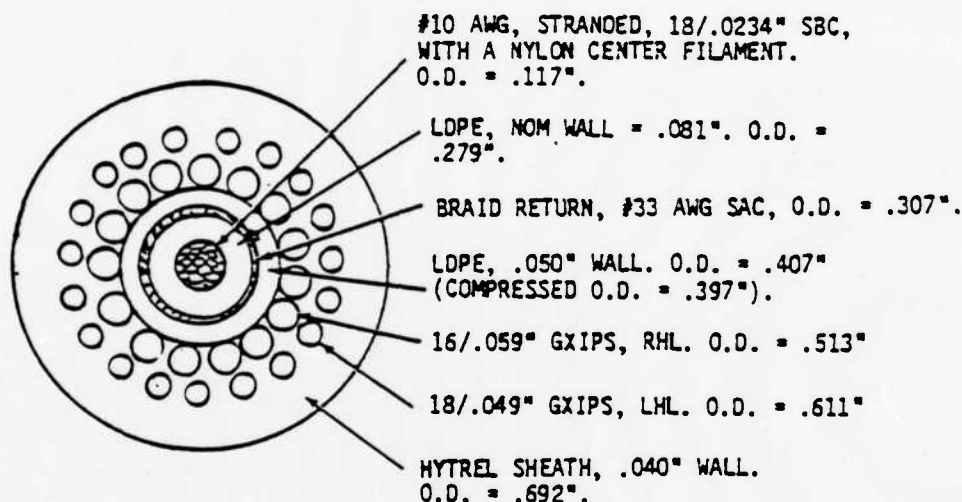
6.8 SHOCK CAPABILITY

The BIP will be capable of surviving 10 Gs of shock input imposed along any axis.

6.9 LOCKOUT DEVICE

The BIP will employ 3 borehole devices released when the BIP cable tension is below 1,500 pounds. The lockout devices will extend out to a maximum radius of 5.5 inches, coupling the BIP to surrounding basalt.

A SUBMARINE TOW CABLE CONSISTING OF (10) #10 AWG COAX WITH AN OVERALL DOUBLE-CAGED ARMOR AND HYTREL JACKET.



ELECTRICAL: NOM CONDUCTOR DC RESISTANCE
@ 20°C:

@10 AWG: 1.08 OHMS/KFT
COAX RETURN BRAID: 1.40 OHMS/KFT
2,500 VOLTS RMS
40 OHMS (REF)
1.4 DB/KFT

VOLTAGE RATING:
CHARACTERISTIC IMPEDANCE:
ATTENUATION AT 500 KC:

MECHANICAL: FILLED SHIELD:

TEMPLUBE BLKNG
COMPOUND.

BREAK STRENGTH:
WEIGHT IN AIR:
WEIGHT IN WATER (SG = 1.027)

21,000#
462 #/KFT
295 #/KFT

TORQUE BALANCED DESIGN

FIGURE 6-3 MSS EM CABLE

SECTION 7.0 - DEPLOYMENT EQUIPMENT

7.1 BIP REENTRY SUB

7.1.1 Configuration

The reentry sub will be an approximate 16 by 27 inch by 73 foot long subassembly. Drawing MSSA02-D002 defines the reentry sub.

7.1.2 Weight

The BIP reentry sub plus BIP package will weigh a maximum of 24,000 pounds.

7.1.3 BIP Attachment

The BIP will be securely attached by a BIP carriage inside the reentry sub.

7.1.4 BIP Release Mechanism

A BIP release mechanism will be provided as part of the reentry sub. The BIP will be released by salt water hydraulic actuation of 2 cylinders. Four shear pins are simultaneously released causing the carriage to move to the reentry sub center release position.

7.1.5 BIP Lowering

The BIP will be guided into the center of reentry sub and lowered into the borehole at a controlled rate, not to exceed 20 ft/min. The lowered position is to be monitored.

7.1.6 Drill Pipe Attachment

The reentry sub will attach through a standard tool joint to the 5 inch drill string bottom hole assembly as shown in GMDI Drawing MSSA02-D001.

7.1.7 Shock Capability

The reentry sub will be designed to withstand the shock loads during reentry for maximum of 24 Gs. In addition, shock isolation for the BIP will be provided to limit shock loading to 10 Gs.

7.1.8 Data Monitoring

The reentry impact data will be monitored and recorded as real time during the reentry.

7.1.9 Cable Interference

The reentry sub will be designed to prevent wear on the EM Cable during lowering and avoid contact during withdrawal.

7.2 SONAR REENTRY TOOL & EM CABLE

7.2.1 Reentry Tool

The reentry tool will be the existing Glomar Challenger on-board sonar reentry tool.

The following measurements are provided:

- o Search Sonar - Maximum 500 foot Range - 360° Azimuth
- o Azimuth Sector
- o Short Range Scanning

7.2.2 Cable Configuration

The sonar reentry tool EM Cable will be a standard Schlumberger 5/8 inch diameter by 7 inch, conductor cable.

7.2.3 Cable Strength

Maximum cable tensile strength is 21,000 pounds.

7.3 EM CABLE WINCH

7.3.1 Capability

An EM Cable winch with slip rings will be provided to accommodate 30,000 feet of 0.692 inch coax cable on the storage reel. 500 feet of 5/8 inch wire rope, 21,500 feet of 1-3/4 inch diameter polyester braided line and 28,000 feet of 7/8 inch polyester braided line will also be run through the winch.

7.3.2 Tensioning Capability

A variable constant EM Cable tensioning capability of up to 15,000 pounds continuous, 20,000 pound maximum, is to be provided.

7.3.3 Payout Capability

A variable speed payout capability up to 50 feet per second is to be provided.

7.3.4 Monitoring

Cable tension and payout length is to be provided.

7.3.5 Structure Mounting

The winch 8 inch by 6 inch steel tubing frame will be welded directly to the special ship mounted foundation piece.

7.3.6 Size and Weight

The Pengo EM Cable Winch will be approximately 110 inches high, 91 inches wide with an overall length of 232 inches. A clearance of 30 inches on the right hand side is required for slip rings and hydraulic motor. It will weigh an approximate 38,000 pounds loaded with wire.

7.3.7 Cable/Line Capabilities

The EM winch will be designed to accommodate the EM cable, 1-1/2 inch wire cable, 1-3/4 inch power braid and 7/8 inch power braid.

7.3.8 EM Cable Interconnection

The EM Cable will be terminated into a separate interconnection to the winch slip rings.

7.4 OVERSIDE A-FRAME STRUCTURE

7.4.1 Size and Configuration

A removable 28 foot long cantilevered A-Frame extends approximately 18 feet over the port side. The A-Frame is rated for 20,000 pounds load. The A-Frame is supported off the casing rack and subbase structure and by a center mounted heave compensator.

7.4.2 Deployment

The A-Frame is to be deployed overside during the test.

7.4.3 A Frame Sheaves

An approximate 30 inch diameter snatch block for the EM cable and 24 inch diameter sheave for the IRR line will be provided at the outboard end of the A-Frame. A manually operated guide rail trolley will be provided for inboard servicing of the A-Frame sheave.

7.5 DYNAMIC TENSIONING EQUIPMENT

7.5.1 Description

A passive heave compensation system will be attached to the cantilevered A-Frame to reduce the dynamic EM Cable loading.

7.5.2 Equipment

A refurbished air/oil guideline tensioner will be utilized to provide a variable stroke support to the A-Frame. The 5 inch diameter by 6 foot stroke tensioner is rated at 64,000 pounds. Two accumulators will be utilized. High pressure air from the Glomar Challenger will be piped to the manifold console.

7.5.3 Operation

An approximate mid-position will be established by the normal static loading condition and gas pressurization levels. Increased/decreased dynamic loadings will lower/raise the A-Frame end position thereby effectively paying-out or pulling-in more cable.

7.6 SHIPBOARD TEST CONSOLE (STC)

7.6.1 Size and Weight

The STC will be 8 feet by 8 feet by 14 feet. It will weigh an estimated 9,000 pounds loaded.

7.6.2 Shipboard Mounting

The STC shall be welded to the deck on four short pieces of vertical foundation channel.

7.6.3 Construction

The STC shall be constructed so as to be completely watertight. All inside and outside wall, ceiling and floor spaces shall be metal or high strength glass. Interior walls and/or components shall be constructed of fireproof material.

7.6.4 Electrical Interface

The STC to ship's electrical interface shall include the following interface signals:

- o STC Input Power
- o Voice Communications
- o Universal Standard Time (WWV) Signal

Electrical output plugs will be provided for the DARS as follows:

- o Strip Chart Recorder
- o WWV Single
- o Coaxial Cable
- o Communications

7.6.5 STC Input Power

The input power capability will be 60 cycle 12 kW 208 VAC, 3 Phase, 4 wire, WYE connected with safety ground.

SECTION 8.0 - IRR SUBSYSTEM

8.1 BPP BOTTOM PACKAGE

8.1.1 Sled Dimensions

The BPP bottom package will be approximately 8 feet by 8 feet by 7 feet high. Figure 8-1 depicts the typical configuration.

8.1.2 Spheres

The BPP will support 3 OBS type aluminum spheres each 40.5 inches in diameter. The spheres will be rated for 20,000 foot depth capability.

8.1.3 DARS

The DARS electronic recording package will be mounted within one sphere. Figure 8-2 depicts the schematic of the DARS electronic network.

8.1.4 Batteries

The silver zinc batteries will be installed in two spheres.

8.1.5 Weight

The BPP will weigh approximately 10,000 pounds dry and 4,500 pounds wet.

8.1.6 Bottom Skirt

A 12 inch mud skirt will be used to stabilize the BPP in the surface sediment.

8.1.7 EM Cable Termination

The EM Cable will be mechanically terminated near the bottom of the BPP package on a pivoted arm.

011-017

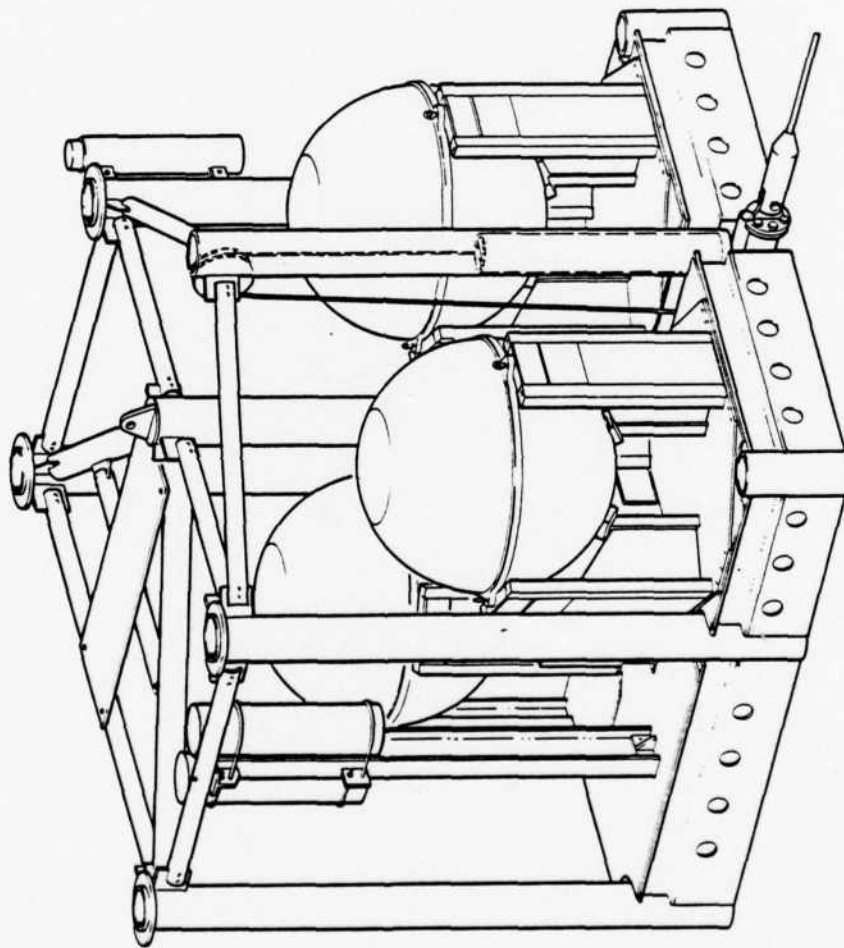
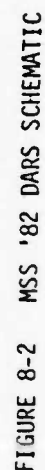


FIGURE 8-1 MSS 82 BPP (BOTTOM PROCESSING PACKAGE)



8.1.8 Lift Eye

A permanent lift dual eye at the center top of the BPP will be provided for the mooring line and shipboard handling crane.

8.2 IRR MOORING/RECOVERY SYSTEM

8.2.1 Configuration

Figure 8-3 depicts the entire IRR system.

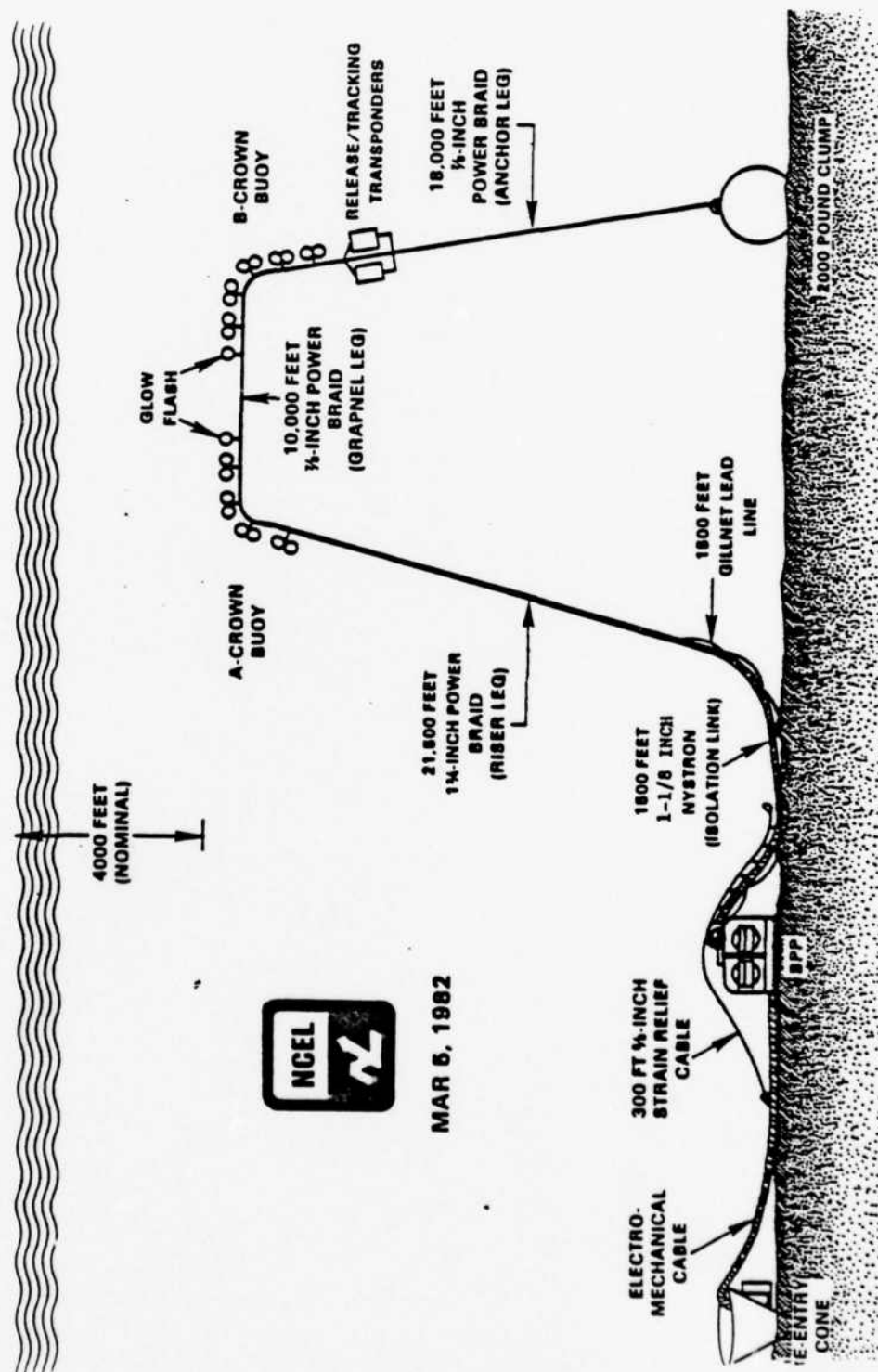
8.2.2 Weight Characteristics

Table 8.1 presents a dry and wet weight estimate of the system.

8.2.3 Strain Relief Cable

A strain relief cable attached to the EM Cable will be provided to hold off the EM Cable during BPP servicing.

MSS 82 **INSTALLATION, RECOVERY &** **REINSTALLATION STRUCTURE**



MAR 5, 1982

FIGURE 8-3 IRR SYSTEM

TABLE 8.1
IRR SYSTEM WEIGHT ESTIMATE

	WEIGHT (POUNDS)		REMARKS
	DRY	WET	
BPP	9,600	4,900	8 x 8 x 7 FT SLED
SWIVEL (BPP)	35	30	
WIRE CABLE	3,195	2,812	1,500 FT, 1-1/8 IN. WIRE ROPE
STRAIN RELIEF CABLE	200	176	300 FT, 5/8 IN. WIRE ROPE
LIFTING LINE	16,985	-645	21,500 FT, 1-3/4 IN. POLYESTER BRAID
A CROWN BUOY	368	-408	8, 17 IN. DIA GLASS SPHERE BUOYS WITH HARD HAT
A FLASHER/REFLECTOR	15	-4	1, WITH HARD HAT
A BUOY PENDANT	11	8	5, 15 FT OF 1/2 IN. POLYESTER BRAID
B CROWN BUOYS	460	-510	10, 17 IN. DIA GLASS BUOYS WITH HARD HAT
B FLASHER/REFLECTOR	15	-4	1, WITH HARD HAT
B BUOY PENDANTS	13	10	6, 15 FT OF 1/2 IN. POLYESTER BRAID
GRAPNEL LINE	1,970	-79	10,000 FT, 7/8 IN. POLYESTER BRAID
DUAL ACOUSTIC RELEASE	30	20	
ANCHOR LINE	3,546	-720	18,000 FT, 7/8 IN. POLYESTER BRAID
SWIVEL (ANCHOR CLUMP)	5	4	
CHAIN & SHACKLES	30	27	10 FT, 1/2 IN. CHAIN
CLUMP ANCHOR	2,000	1,600	STEEL BALL
CONNECTIONS	25	20	
(LIFT LINE)			
MISC HARDWARE	50	44	BOLTS, NUTS, THIMBLES ETC

SECTION 9.0 - GLOMAR CHALLENGER MODIFICATION

9.1 GENERAL REQUIREMENTS

The below defined equipment installations are to be quickly accomplished in port and must be capable of being retrofitted to original condition.

9.2 EM CABLE WINCH

Install on main deck area a diesel powered 34,000 foot EM Cable winch assembly.

9.3 A-FRAME

Install an approximate 10 ton overside A-Frame deployable structure amidships on the port side.

9.4 BIP DATA CONSOLE VAN (STC)

Install a real time data log and recorder van. Provide 12 kVA, 220/440 V, 3-Phase, 60 Hz, ship's power to STC van. Also, interconnect with ship's communication network.

9.5 BIP

A horizontal rack for 2 BIP units is to be provided in the casing rack area.

9.6 REENTRY SUB

A rack for 1 reentry sub including 2 stingers will be provided.

9.7 BPP

Space in the 'tween decks storage area is to be provided for maintenance of the BPP subsea bottom package. Temporary space on the port side casing main deck area is required for final deployment.

9.8 IRR MOORING LINE

Space for 51,000 feet of 1-3/4 and 7/8 inch diameter synthetic mooring line is to be provided on main deck near EM winch.

9.9 IRR SUBSURFACE BUOYS

Space for several IRR mooring subsurface buoys is to be provided on port side main deck area forward of house.

9.10 DARS CHECKOUT CONSOLE

A 7 conductor temporary communications cable is to be run from the STC van to the 'tween deck test area and the port main deck final checkout area. Cable requirements are:

- | | | |
|---|------------------------|----------------------|
| 1 | - EM Cable Signal | RG582/U Coax |
| 2 | - Strip Chart Recorder | #20 AWG Twisted Pair |
| 2 | - Voice Communications | |
| 2 | - WWV Audio Signal | #20 AWG Twisted Pair |

Power requirements in the 'tween deck area will be 1KVA 220 volt single phase 50 amp circuit.

SECTION 10.0 - AUXILIARY MEASUREMENTS

10.1 CURRENT METER ARRAY

A full depth readout capability current meter is desired from the support ship during the reentry tests. Current data will be provided to the Glomar Challenger via radio-telephone from the support ship.

10.2 OCEAN BOTTOM SEISMIC PACKAGE (OBS)

The OBS packages will be launched during the test and recovery by the support ship.

10.3 ATNAV ARRAY

The ATNAV system will be operated aboard the DeSteiguer. The DeSteiguer will put down some of the ATNAV transponders; the Glomar Challenger will put down the acoustic releases and some of the ATNAV transponders.

SECTION 11.0 - SUPPORT SHIP

11.1 INITIAL DEPLOYMENT

The AGOR type research vessel USNS DeStieguer, has been committed as the support ship.

11.2 RECOVERY AND REDEPLOYMENT

A Navy T-ATF fleet tug has been assigned for the initial recovery operation.

APPENDIX C

MSSA02-SYS-P002

MSS '82 DEPLOYMENT OPERATIONS PROCEDURES

MSSA02-SYS-P003

MSS '82 INTEGRATED LOGISTICS PLAN FOR
MOBILIZATION PHASE IV DEPLOYMENT

(THESE DOCUMENTS FOR REFERENCE ONLY - NOT INCLUDED)

APPENDIX D

LIST OF APPLICABLE DRAWINGS
MSS '82 DEPLOYMENT PROGRAM

MSS '82 DRAWING LIST

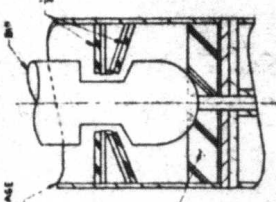
*MSSA02-MTL-D001 MSS 82 MODIFIED BIP REENTRY SUB WITH STINGER CONTROL DRAWING
*MSSA02-MTL-D002 MSS 82 MODIFIED REENTRY ASSEMBLY CONTROL DRAWING
MSSA02-MTL-D003 MSS 82 BIP CARRIAGE CONTROL SUB DETAIL & ASSEMBLY
MSSA02-MTL-D004 MSS 82 MODIFIED BIP CARRIAGE HOUSING ASSEMBLY & DETAILS
(SHTS 1-2)
MSSA02-MTL-D006 MSS 82 MODIFIED BIP CARRIAGE HOUSING MAIN ASSEMBLY
MSSA02-MTL-D007 MSS 82 MODIFIED BIP REENTRY SUB ASSEMBLY
MSSA02-MTL-D010 MSS 82 IDLER SHEAVE SUPPORT DETAIL ASSEMBLY (SHTS 1-2)
MSSA02-MTL-D011 MSS 82 SONAR SINKER BAR ASSEMBLY & DETAILS (SHTS 1-2)
MSSA02-MTL-D012 MSS 82 REENTRY SUB STINGER ASSEMBLY & DETAILS (SHEETS 1-2)
MSSA02-MTL-D013 MSS 82 BAKER VALVE & SINKER BAR ADAPTOR MODIFICATIONS,
DETAILS AND ASSEMBLY
MSSA02-MTL-D014 MSS 82 BIP JACKING SCREW DETAIL
MSSA02-MTL-D015 MSS 82 EM CABLE TERMINATION ON WINCH REEL MODIFICATION DETAIL
MSSA02-MTL-D016 MSS 82 HYDRAULIC PLUG/SONAR ADAPTER MODIFICATION
MSSA02-MTL-D017 MSS 82 BAKER EQUALIZING CHECK VALVE MODIFICATION
*MSSA02-MTL-D018 MSS 82 GLOMAR CHALLENGER EQUIPMENT INSTALLATION ARRANGEMENT
(SHTS 1-2)
*MSSA02-MTL-D019 MSS 82 A-FRAME DETAILS & ASSEMBLY
MSSA02-MTL-D022 MSS 82 EM CABLE WINCH LAYOUT OF EXHAUST SYSTEM
MSSA02-MTL-D023 MSS 82 CABLE PROTECTOR & RING GAGE ASSEMBLY DETAILS
MSSA02-MTL-D024 MSS 82 CENTERING SPRING SONAR SINKER BAR ASSEMBLY
MSSA02-MTL-D025 MSS 82 TROLLEY & JACKING SCREW DETAIL LAYOUT
MSSA02-MTL-D030 MSS 82 BIP HOUSING SUPPORT BRACKETS
MSSA02-MTL-D031 MSS 82 IRR LINE STORAGE CONTAINER SECURING DETAILS
MSSA02-MTL-D032 MSS 82 REENTRY GUIDE CONE INSTALLATION LAYOUT
MSSA02-MTL-D034 IRR CUSTOM 2 PLATE CONNECTOR
*MSSA02-MTL-D049 GLOMAR CHALLENGER ELECTRICAL INSTALLATION (SHEETS 1-3)
MSSA02-STR-D001 EM CABLE RECOVERY PLATFORM

* These copies only are included in Appendix D of this report.

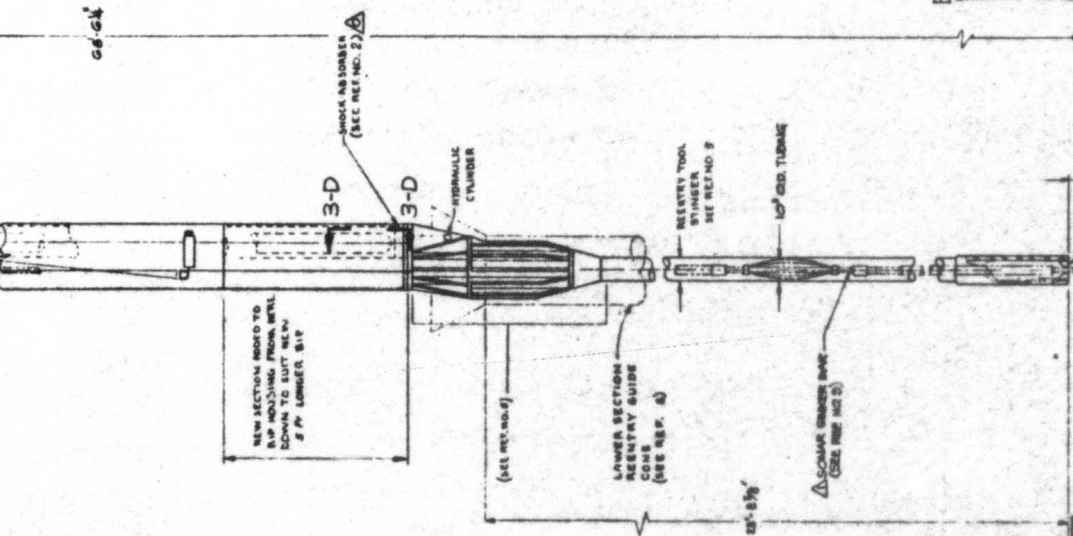
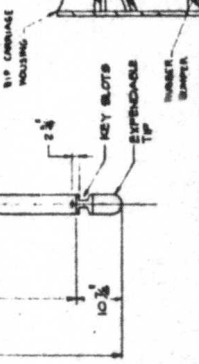
LIST OF MATERIALS			
ITEM	QTY	DESCRIPTION	REMARKS
1	1	MTL-DOO1 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
2	1	MTL-DOO2 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
3	1	MTL-DOO3 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
4	1	MTL-DOO4 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
5	1	MTL-DOO5 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
6	1	MTL-DOO6 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
7	1	MTL-DOO7 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
8	1	MTL-DOO8 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
9	1	MTL-DOO9 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5
10	1	MTL-DOO10 BIP ATTACHMENT 4-12	REWORK/NO. 1/2/3/4/5

REFERENCE LIST

1. MTL-DOO1 BIP ATTACHMENT 4-12
2. MTL-DOO2 BIP ATTACHMENT 4-12
3. MTL-DOO3 BIP ATTACHMENT 4-12
4. MTL-DOO4 BIP ATTACHMENT 4-12
5. MTL-DOO5 BIP ATTACHMENT 4-12
6. MTL-DOO6 BIP ATTACHMENT 4-12
7. MTL-DOO7 BIP ATTACHMENT 4-12
8. MTL-DOO8 BIP ATTACHMENT 4-12
9. MTL-DOO9 BIP ATTACHMENT 4-12
10. MTL-DOO10 BIP ATTACHMENT 4-12



DETAIL VIEW 3-D



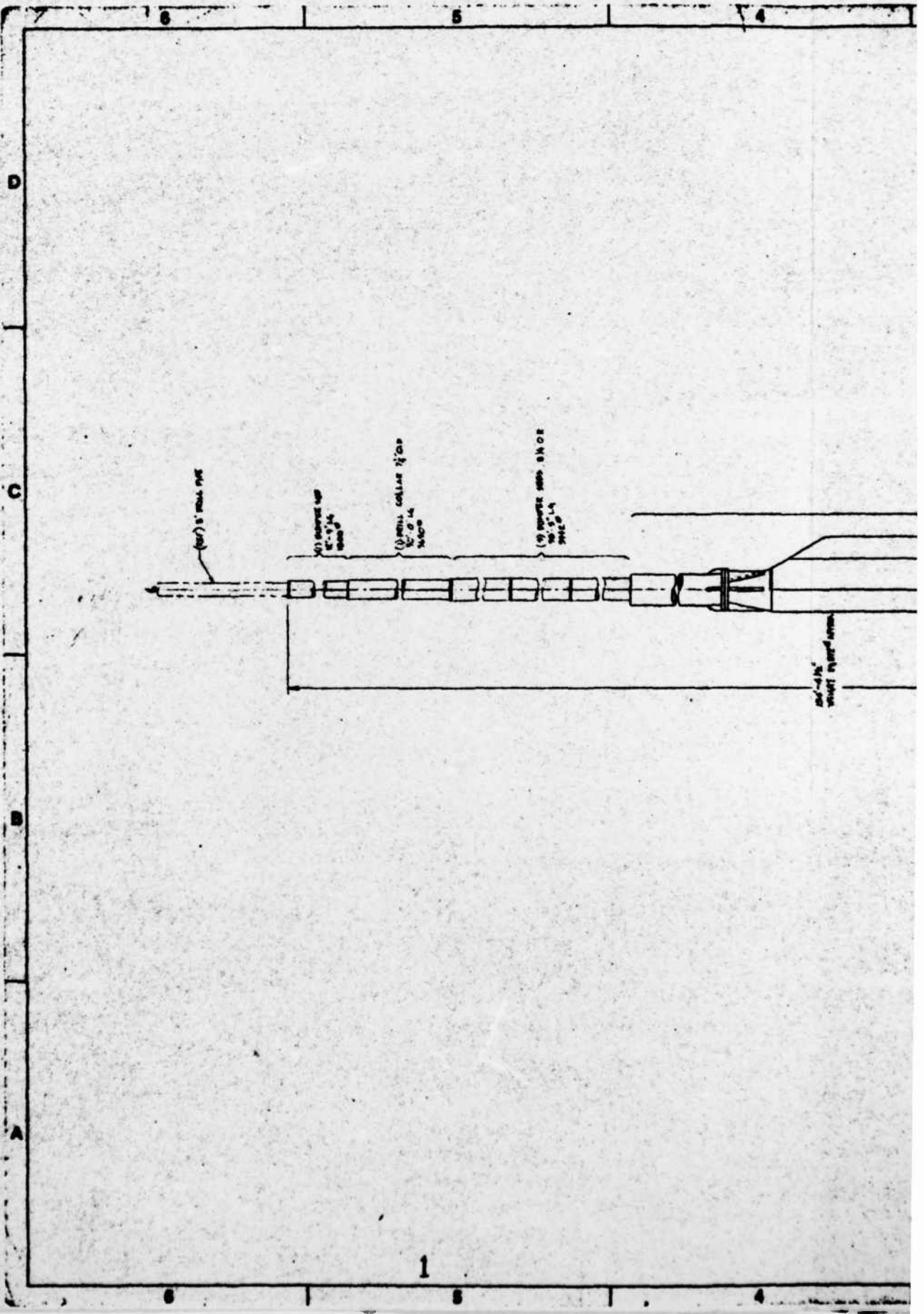
DETAIL A-3
SONAR SINKER BAR
(SEE REF. 5)

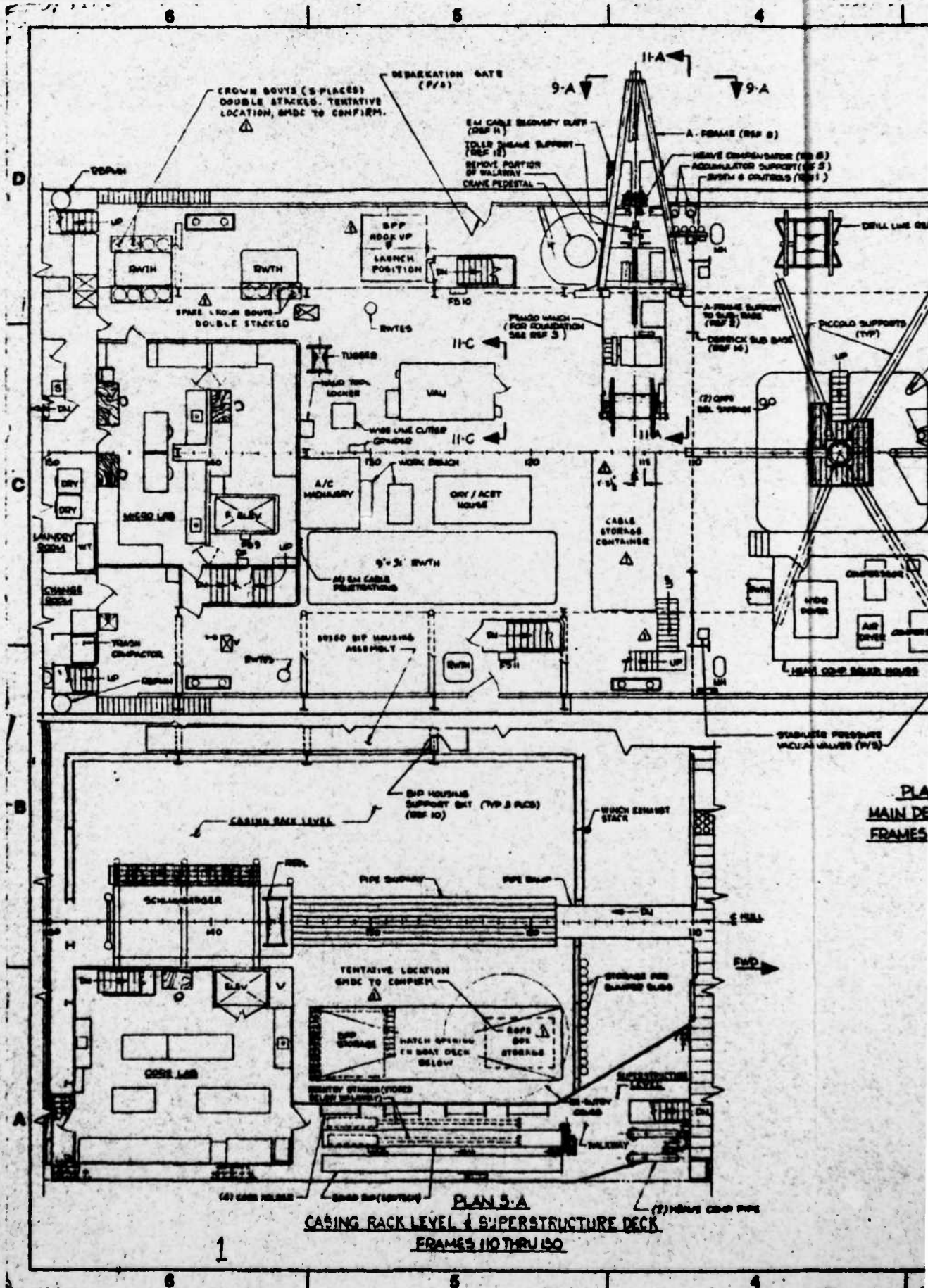
ADDED REFERENCE NOTES TO (BASE ON-410) ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISIONS (SEE DCH-DOO 1): REVISION NO. 1 & 2: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 3: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 4: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 5: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 6: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 7: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 8: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 9: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 10: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 11: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 12: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 13: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 14: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 15: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 16: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 17: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 18: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 19: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	
REVISION NO. 20: ADDED SONAR SINKER BAR-DETAIL A-3 (SEE REF. 5) IN PARAGRAPH ON BIP 2-B, PER DCH-DOO 1	

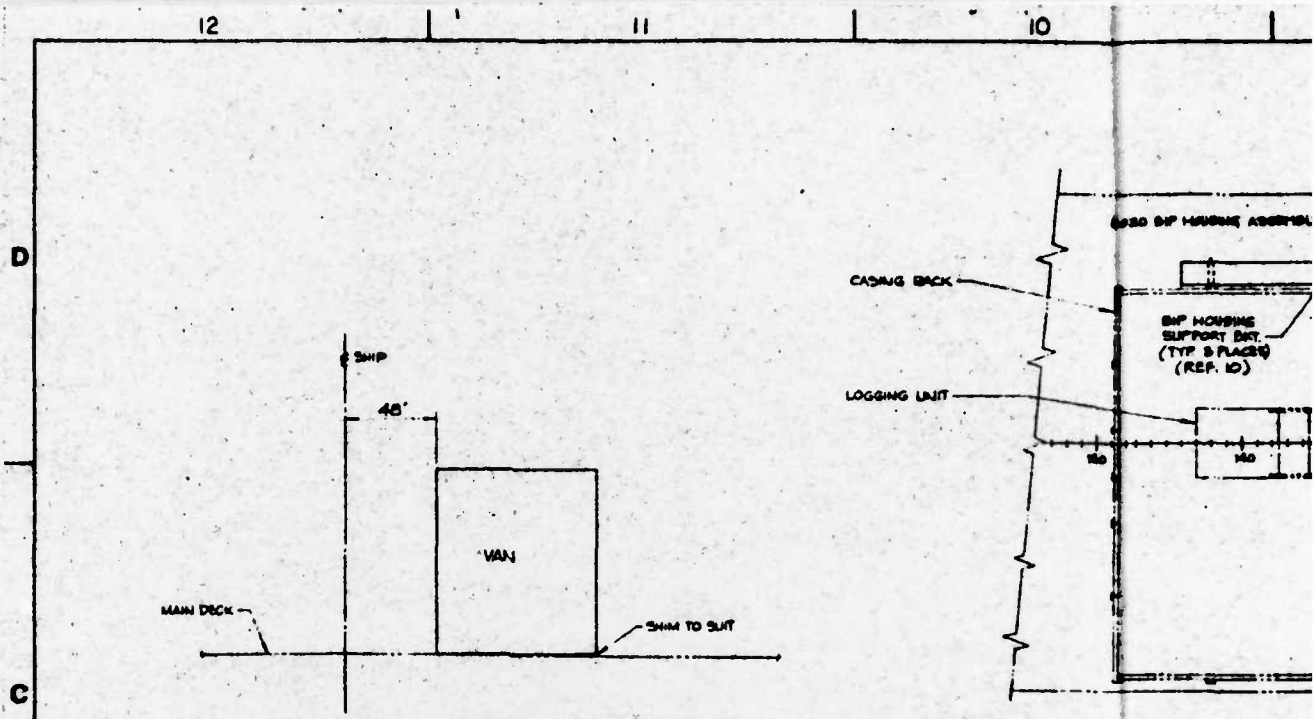
GLOBAL MARINE DEVELOPMENT INC.
Alameda Blvd. Calif.

MARINE GENIE SYSTEMS (MGS) - BE MODIFIED BY REENTRY SUB WITH STINGER CONTROL (DCH-DOO 1)

DATE: 11/1/81
BY: [Signature]
CHECKED: [Signature]
APPROVED: [Signature]

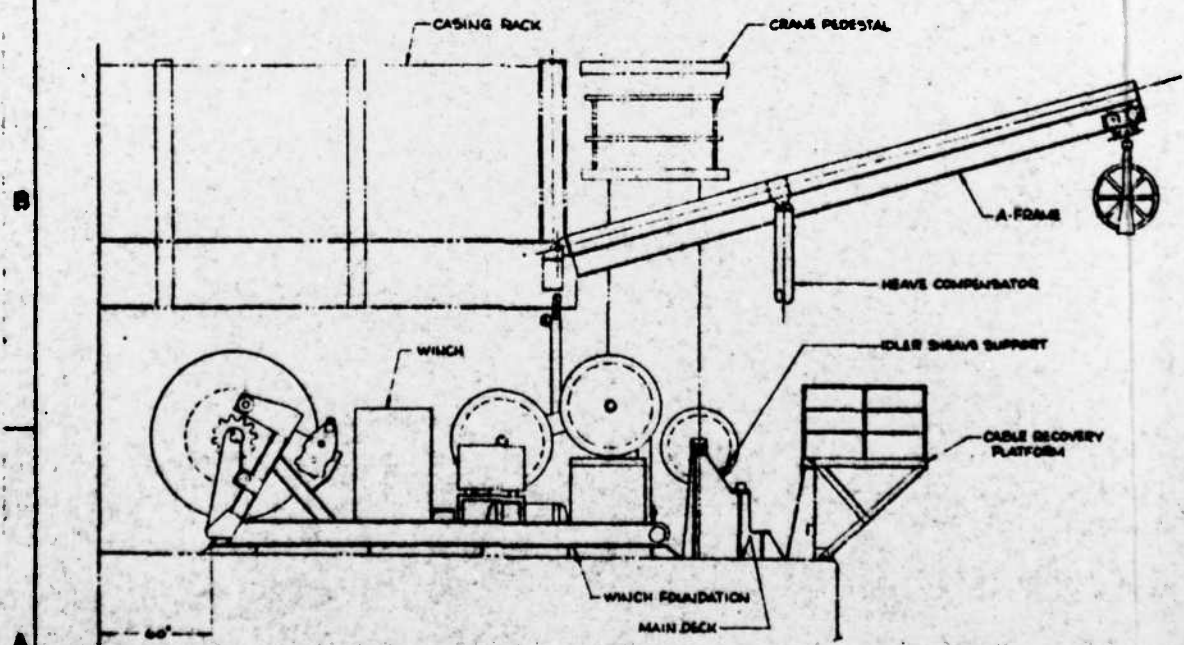






ELEVATION 11-C
 SCALE: 3/8" = 1'-0"
 (SEE 4-B)
 (VIEW LOOKING RT)

PL
 RE-ENTRY TOOL
 904



SECTION 11-A
 SCALE: 3/8" = 1'-0"
 (SEE 4-B)
 (VIEW LOOKING RT)

10

9

8

7

LIST OF MATERIALS

CRANE PEDESTAL

BRED DIP HOUSING ASSEMBLY

BHP HOUSING
SUPPORT BKT
(TYP 3 PLACES)
(REF. 10)

WINCH

SHIP

CABLE STORAGE

PLAN 9-C

RE ENTRY TOOL & MISC EQPT STORAGE

SCALE: 1/4" = 1'-0"

A-FRAME & WINCH

A-FRAME

A-FRAME SUPPORT
TO CABING RACKA-FRAME SUPPORT
TO SUB-BATH

WINCH

CABLE RECOVERY PLATFORM

BULKHEAD

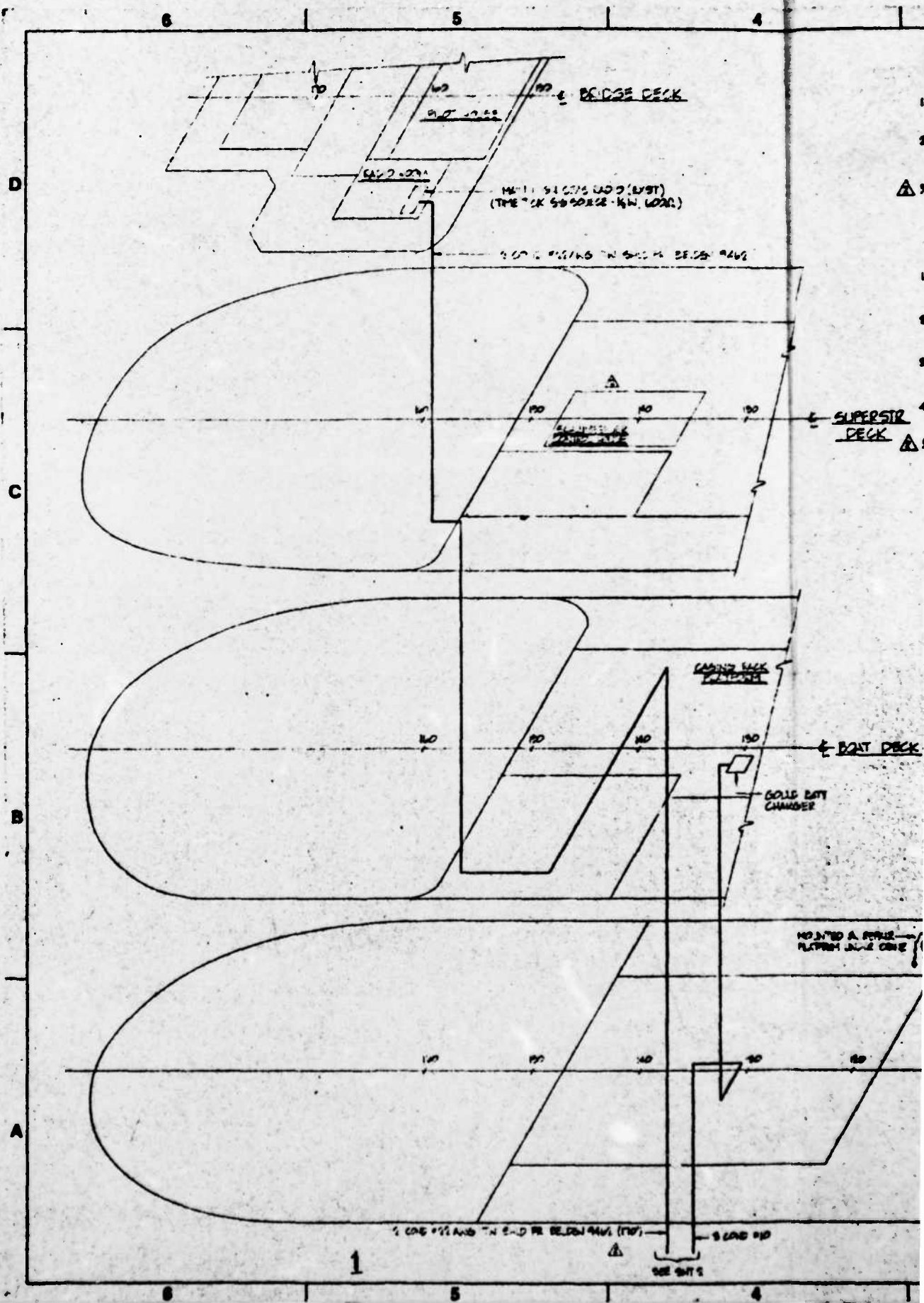
MAIN DECK

ELEVATION 9-A

SCALE: 1/4" = 1'-0"
(SEE 8-B)

(VIEW LOOKING ABOARD)

GLOBAL MARINE DEVELOPMENT Inc.	
MARINE SEISMIC SYSTEM (MSS-82)	
GLOBAL CHALLENGER	
EQUIPMENT INSTALLATION ARRANGEMENT	
DATE	ISSUED
10/15/82	10/15/82
PROJECT: E MSSAC2-MTL-0015 41-211	



1. THIS DRAWING IS AN 'AS BUILT CONDITION' DRAWING AND SUPERSEDES THE INSTALLATIONS SHOWN ON REFERENCES N^o 1 AND 2.
2. FOUR (4) HEAD-CHST SETS (ITEM 16) ARE PROVIDED, THREE (3) WITH SOFT EXTENSION CORDS AND ONE (1) WITH 15' EXTENSION WITH ASSOCIATED PLUGS (ITEM 15).
3. THIS DRAWING IS MODIFIED BY AND TO BE USED IN CONJUNCTION WITH REFERENCE N^o 13. FOR USE OF THE INSTALLATION HEREBY IS EXISTING AND IS TO BE RECONNECTED AS SHOWN EXCEPT AS MODIFIED BY REFERENCE N^o 13.

1. E-001-001 MARINE SEISMIC SYSTEM (MSS)
GLIMAR CHALLENGER
ELECTRICAL INSTALLATION
2. MSSA02-MTL-0020 MARINE SEISMIC SYSTEM (MSS)-02
GLIMAR CHALLENGER
ELECTRICAL INSTALLATION
3. MSSA02-MTL-0019 MARINE SEISMIC SYSTEM (MSS)-02
1" FRAME
DETAILS & ASSEMBLY
4. MSSA02-MTL-0018 MARINE SEISMIC SYSTEM (MSS)-02
GLIMAR CHALLENGER
EQUIPMENT INSTALLATION ABERT
5. MSSA04-SYS-0001 MARINE SEISMIC SYSTEM (MSS)-03
GLIMAR CHALLENGER
ELECTRICAL INSTALLATION

[illegible][illegible]

